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# INVENTORYING AND MONITORING OF AQUATIC PLANT DIVERSITY OF FLUVIAL ECOSYSTEM OF RAJAJI NATIONAL PARK, UTTARAKHAND, INDIA

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**Abstract :** Aquatic plant diversity and the physico-chemical characteristics of the aquatic habitat of Song and Suswa river flowing in the Rajaji National Park, Uttarankhand, has been monitored seasonally. Four sampling sites $S_1$, $S_2$, $S_3$ and $S_4$ were identified. $S_1$ and $S_2$, at Song river $S_3$ and $S_4$ at Suswa river of Rajaji National Park. Seasonal sampling was done and the study revealed that diversity has been found to be high in winter months comparatively due to low turbidity, high water transparency, high dissolved oxygen and low water velocity

**Keywords:** Inventoring, Monitoring, Physico-chemical parameters, Aquatic, Habitats, Rajaji National Park

## INTRODUCTION

Biodiversity or biological diversity encompasses all species of plants, animals and micro-organisms and the ecosystems and ecological processes of which they are parts. It is an umbrella term for the degree of nature's variety including both the number and frequency of ecosystems, species or genes in a given assemblage. Human survival depends on biodiversity, not only for food, fibre and health but also for recreation. yet human activities particularly for the last two decades, have led to extinction of many spacio-temporal variations in biodiversity and relationship of biodiversity with ecosystem stability and resilience have been the subject of concern of ecologists for some time now (Odum,1971). Aquatic biodiversity has been recognised as one of the most potential and essential characteristics of life for proper functioning of fluvial ecosystem and as a means for coping with natural and anthropogenic environmental changes. Aquatic biodiversity reflects the conditions existing in the environment and estimates the biological monitoring of water pollution level. For ascertaining the biological status of the river, the qualitative and quantitative investigations of trophic levels including Phytoplankton and Periphytic biota are important.The contribution on aquatic plant diversity of freshwater ecosystems have been made by Berner 1951; Schmitz 1954 1961; Douglas 1958; Mc Conell and Singler 1959; Whitford 1960; Grezenda *et al.* 1960; Holden and Green 1960; Woods 1965; Williams 1966; Golterman *et al.* 1969; Hynes 1971; Whitton 1975; Crayton and Summerfield 1979; Sze 1981; Stevenson 1984, 1996; Biggs and Close 1989; Allan and Flecker, 1993; Biggs 1995, 1996, 1998; Biggs and Thompson 1995; Biggs and Gerbeaux 1993; Benson-Evans *et al* 1975; Haury 1996; Allan 1997; Quinn *et al.* 1997; Clausen and Biggs 2000; Biggs *et al.* 1998; Pollock *et al.* 1998; Horner *et al.*1990; Biggs, 1996, Clausen and Biggs 1999; Iida and Ladona 2000, Smith *et al*. 2000; Walsh *et al*. 2001, Rojo *et al.* 2002; Hankinson and Blanch 2003; Harrison *et al*. 2004 and Sharma 2002, 2005).

### Study Sites

Rajaji National Park is situated in the foothills of Shiwalik Range of the newly carved out state Uttarakhand. It is the part of the Dehradun, Hardwar and Pauri district of Uttarakhand.

Three sanctuaries, Motichur Sanctuary (59.5sq.km), Rajaji Sanctuary (247.0sq.km), Chila Sanctuary (249.02sq.km) and other reserve forests (234.5sq.km) are amalgamated into large protected area which is named as Rajaji National Park. The total area of the Rajaji National Park is 820.42km$^2$. To the north of the Rajaji National Park lies the Dehradun and Tehri Forest Division. River Suswa forms the northern natural boundary upto Ganges.

River Ganges divides the Park into two units, the Chila Sanctuary complex in the east and Rajaji Motichur Sanctuary Complex in the west. To the south of Rajaji lies the revenue lands and villages of Haridwar District. Part of south eastern portion is covered by Bijnore forest division. The Garhwal forest division lies to the east of the park. Rawsan river forms a small portion of natural south eastern boundary of the park. To the west of the Rajaji lies the Shiwalik Forest Division. Song and Suswa are two perennial rivers draining Rajaji National Park in north eastern slopes of Shiwalik. The north eastern slopes of Shiwaliks are very steep and rugged in the upper portion but in the lower portion it has a quiet easy gradient. There are large number of short, shallow dry and bouldery streams locally known as "raus"coming down from upper slopes and carring their discharge into Song and Suswa rivers. The forest on both the sides of the Suswa river is more or less on flat or gently sloping area often cut by nalas. The forests of eastern Doon are drained by Suswa and Song rivers. River Song and Suswa form its confluence in the Banbaha forest block. From there, it flows in a south eastern direction till it discharges into the Ganges near Satyanarian. Some seasonal

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tributaries also meet Song and Suswa river at Bindal, Rispana, Ren and Jakhan The river Suswa flows very nearly opposite to Asan river to the east of Saharanpur-Mussoorie highway and flows in a south easterly direction to discharge into the Song. After a preliminary survey of Song and Suswa river, four sampling sites ($S_1$, $S_2$, $S_3$ and $S_4$) were selected. $S_1$ and $S_2$ were identified at Song river and $S_3$ and $S_4$ were identified at the Suswa river. Site $S_1$ was selected at Shampur, $S_2$ at Chidderwala, $S_3$ at Satyanarian and $S_4$ at Kansrao.

Considerable work has been done on the teresstrial biodiversity of Rajaji National Park (Diwakar; 1995, Panwar and Mishra; 1994), but less information is available so far on the aquatic plant diversity and the function of fluvial ecosystem of Rajaji National Park. Therefore the present work on the inventoring and monitoring of aquatic plant diversity of the river Song and Suswa of Rajaji National Park was carried out.

## MATERIAL AND METHOD

Sampling was conducted seasonally winter (November-February), Summer (March-June) and Monsoon (July-October). Air and Water temperature was recorded with the help of a Centigrade 0-110 $^0$C thermometer. The mean velocity was measured using electromagnetic current meter (model-PVM-2A). pH was estimated by control dynamics pH meter (model-APX15\C) while turbidity was measured by turbidity meter (model-5D1M). Nitrates and phosphates were estimated by the spectrophotometer (Spectronic 20D Series) and sodium and potassium were estimated by the digital flame photometer (model-1381). Dissolved oxygen and Free $CO_2$ were measured following methods outlined in APHA (1998). The control dynamics conductivity meter (model-API 185) was used for measuring conductivity. All these parameters were determined following the standard methods outlined in Welch (1952), APHA (1998) and Wetzel and Likens (1992). Some of the physico-chemical parameters were analised at the spot and rest were determined at the laboratory. For the analysis of biological parameters, the samples of periphyton were preserved in 4% formalin for quantitative study, while phytoplankton was preserved in Lugol's solution and 3% formalin, respectively. The quantitative analysis was made by using Ward and Whipple (1992) and several taxonomic keys and manuals of Freshwater Biological Association, UK.

The percentage cover of different sized substrata within each surber quadrate was estimated visually using the substrate size classes (after Bovee and Milhous 1978) of sand (0.06-2mm), fine gravel (2-32mm), coarse gravel (32-64mm), cobbles (64-256mm) and boulders (>256mm) with Surber Sampler (0.5mm mesh net) to a depth about 10cm in a quadrat. Samples were preserved in 4% formalin.

## RESULT AND DISCUSSION

Periphytons (attached algae) are also the dominant primary producers in the fluvial system of Rajaji National Park. A total of 51 genera of periphyton were recorded from the fluvial ecosystem of Rajaji National park. Periphyton were represented by Bacillariophyceae (38 genera), Chlorophyceae (9 genera) and Myxophyceae (4 genera) Table2. Periphyton community showed maximum abundance during winter season and minimum during monsoon season. Maximum periphytonic biomass was observed in Danish lowland streams during spring season (Sand Jenson *et al.* 1988). Gusain (1991) recorded maximum periphyton biomass during winter in Bhilangana river, Garhwal Himalayas. While Shamsudin and Sleigh (1994) recorded maximum periphyton biomass during spring season in Chalk stream and soft water stream. Moore (1997) and Morin (2004) recorded an increase in periphytic biomass in sub-arctic streams during summers when low temperature was recorded. For temperate streams, Cox (1990) recorded a minimum biomass in winter, with a spring maxima, followed by unpredictable fluctuations in biomass during summer.

The water temperature was recorded maximum (23.95+_1.77$^0$C) in monsoon season and minimum (20.56+_1.43$^0$C) in winter season during the study period. The air temperature was found to be maximum (28.21+_0.86 $^0$C) again in monsoon season and minimum (24.58+_1.84 $^0$C) in winter season The dissolved oxygen was found higher in winter months and minimum in monsoon while free $CO_2$ was found to be maximum in monsoon and minimum in winter while turbidy, conductivity and total dissolved solvents show decreasing trend in summer and winter months. Sodium and potassium show irregular trend in their concentration (Table 1). The water temperature fluctuated with the air temperature at all the four sampling sites. Both air and water temperature were correlated positively (r = 0.804) during the present investigation. Dissolved oxygen showed negative correlation (r = -0.674) with water temperature and turbidity (r = -0.893) during the study period. (Table 3). Welch (1952) stated that capacity of water for oxygen enhanced with the decrease in temperature. The concentration of dissolved oxygen in water gives a measure of photosynthetic production minus loss by diffusion, consumption, decomposition and respiration.

Water temperature was found to have negative relationship with periphyton density(r=-0.747 p>0.02) under the present study. Water current showed a negative relationship with periphyton density in both the rivers (Table 4). Many aquatic plant populations living in the harsh environment of unpredictable flow suffer high mortality from physiological stress during high flow (Cushman 1985).Increased velocities flush and remove attached algae by abrasion from surfaces and may also break off long strand of filamentous

algae (Biggs and Thomsen 1995). Elevated velocities alone can be very destructive for stream periphyton (Boulten *et al*. 1992; Sharma *et al.* 2002, 2005), Peterson and Stevenson 1990). Even rolling of stones occurs during flash floods and creates an unstable habitat for periphyton. The periphyton density was found to be minimum during monsoon season, when the water velocity was found to be maximum. Therefore, it was inferred that low biomass during monsoon season was reasonably due to frequent disturbances (frequent floods and unstable bed sediments) in riverine ecosystem of Rajaji National park.

Periphytonic density was negatively correlated with turbidity. Turbidity was recorded maximum in monsoon season, when the periphyton abundance and diversity was recorded to be minimum. Welch (1952) also pointed out an adverse impact of turbidity on algal populations. Sharma *et al.* (2002) observed that the periphyton loss rate increases as the concentration of suspended solids attained higher concentration. During high flows, increased sediment movement from the catchment area and rainfall reduced the periphyton mass in the fluvial system of Rajaji National park.

No significant relationship was found to occur between dissolved oxygen concentration and periphytonic density. . The total dissolved solids (TDS) showed a significant negative relationship with periphyton density. Biggs and Gerbeaux (1993) also noticed a negative correlation between temporal changes in periphyton biomass and dissolved inorganic nutrient in fresh water ecosystem of New Zealand. Inorganic nutrient supplies are also one of the important driving variables for primary production and potentially act in association with disturbance to set the overall habitat template for periphyton in stream ecosystem (Biggs 1995, 1998)

The amount and nature of biological activities are directly correlated with the concentration of free $CO_2$ available in water (Morin *et al* 2004). During the present investigation very low concentration of free $CO_2$ was observed in water of Song and Suswa rivers. It was recorded higher in monsoon while a low concentration was observed in winters. The rise in monsoon may be attributed due to retarded photosynthetic activity or due to low oxygen consumption by the organic matter in turbid state of water or due to failure of carbon dioxide being poorly utilized during the state of low phytoplankton density (Bhat *et. al.* 1985 and Sharma 2000) **.**

Free $CO_2$ was negatively correlated with dissolved oxygen (r = -0.731) and pH (r = -0.350) during the study period. Reduction in pH is attributed due to influx of carbon dioxide in the form of carbonic acid through rain water (Khan 1994). Similar relationship was also ascertained by Badola and Singh (1981), Nautiyal (1986) and Sharma (1991), in the rivers of Garhwal Himalaya. Conductivity showed a positive correlation with alkalinity and total dissolved solvents during the study period. (Table 3).

Mountain stream may show very little plankton even in their lower course and true plankton is absent in the upper parts of the stream system (Welch, 1952). Periphyton was dominated in winters and early summers while scanty specimens were available during flash floods of monsoon seasons in the fluvial system of Rajaji National Park. (Table 5)

**Table 1.** Seasonal Variations in physico-chemical parameters in the fluvial system of Rajaji National Park.

| Parameters | Winter (Nov.-Feb.) | Summer (Mar.-Jun.) | Monsoon (Jul.-Oct.) |
|---|---|---|---|
| Air temperature ($^0$C) | 24.58±1.84 | 27.31±0.95 | 28.21±0.86 |
| Water temperature ($^0$C) | 20.56±1.43 | 23.69±1.41 | 23.95±1.77 |
| Water current (m sec$^{-1}$) | 0.48±0.11 | 0.58±0.10 | 1.07±0.47 |
| Turbidity (NTU) | 0.00±0.00 | 84.00±6.48 | 81.50±16.29 |
| HMD (cm) | 42.11±1.93 | 44.11±2.84 | 45.96±2.52 |
| Transparency (cm) | 42.11±1.93 | 44.11±2.84 | 45.96±2.52 |
| Conductivity (µm cm$^{-1}$) | 0.34±0.02 | 0.40±0.06 | 0.38±0.04 |
| TDS (mg l$^{-1}$) | 244.3±79.07 | 491.87±80.92 | 607.50±155.11 |
| Dissolved oxygen (mg l$^{-1}$) | 14.48±0.70 | 12.65±1.46 | 10.28±1.67 |
| Free $CO_2$ (mg l$^{-1}$) | 0.33±0.24 | 0.58±0.24 | 0.99±0.67 |
| pH | 8.19±0.24 | 8.21±0.23 | 8.15±0.18 |
| Phosphates (mg l$^{-1}$) | 0.07±0.00 | 0.07±0.00 | 0.07±0.00 |
| Nitrates (mg l$^{-1}$) | 0.02±0.02 | 0.02±0.02 | 0.03±0.02 |
| Chlorides (mg l$^{-1}$) | 4.46±0.40 | 5.58±0.75 | 4.70±0.39 |
| Alkalinity (mg l$^{-1}$ | 20.93±8.20 | 39.06±10.20 | 46.56±9.95 |
| Sodium (mg l$^{-1}$) | 14.18±2.97 | 14.93±2.86 | 18.37±2.52 |
| Potassium (mg l$^{-1}$) | 0.45±0.12 | 0.58±0.09 | 0.75±0.11 |

**Table 2.** Mean seasonal variations in the density (org.m-2) of periphyton dwelling in fluvial system of Rajaji National Park

| Periphyton | Winter | Summer | Monsoon | Autumn |
|---|---|---|---|---|
| **Bacillariophyceae** | | | | |
| *A.lanceolata* | +++ | +++ | _ | ++ |
| A .lanceolata f. capitata | +++ | ++ | + | ++ |
| *A. ovalis* | +++ | ++ | + | ++ |
| *A. bisoletiana* | ++ | ++ | ++ | ++ |
| *A. brevipes* | +++ | ++ | - | ++ |
| *A. clevie* | ++ | +++ | - | ++ |
| *A.exilis* | +++ | ++ | - | ++ |
| *Amphora ovalis* | +++ | ++ | + | ++ |
| *Bacillara paradoxa* | ++ | +++ | -- | ++ |
| *Cyclotella glomerata* | ++ | ++ | - | ++ |
| *Cyclotella stelligera* | ++ | +++ | - | ++ |
| *Cymbella affinis* | +++ | ++ | - | + |
| *C. lacustris* | +++ | - | + | ++ |
| *C. turgida* | +++ | - | + | ++ |
| *Diatoma anceps* | +++ | +++ | - | ++ |
| *D. vulgare* | ++ | ++ | - | + |
| *Fragilaria capucina* | ++ | ++ | - | ++ |
| *F.intermedia* | ++ | ++ | - | ++ |
| *F. lapponica* | +++ | +++ | - | ++ |
| *F. Pinnata* | ++ | - | - | ++ |
| *Gomphonema gracile* | +++ | +++ | - | ++ |
| *G. longiceps* | ++ | +++ | -++ | + |
| *G. subtile* | +++ | + | + | ++ |
| *Hantzschia amphioxys* | +++ | ++ | ++ | ++ |
| *Meridion circulare* | +++ | ++ | + | ++ |
| *Navicula bacillum* | ++ | + | + | ++ |
| *N. radiosa* | +++ | ++ | + | + |
| *N. rostellata* | +++ | ++ | + | ++ |
| *N. dissipata* | ++ | +++ | + | ++ |
| *N. ampibia* | +++ | +++ | + | ++ |
| *N. capitella* | +++ | + | + | ++ |
| *Nitzchia sigmoidea* | +++ | ++ | - | ++ |
| *N. denticulate* | ++ | ++ | - | ++ |
| *N. linearis* | ++ | ++ | - | ++ |
| *Synedra acus* | ++ | ++ | - | + |
| *S. rumpens* | +++ | ++ | - | ++ |
| *S. ulna* | +++ | + | - | ++ |
| *Tabellaria fenestrata* | +++ | ++ | - | ++ |
| **Chlorophyceae** | | | | |
| *Chlomydomonas spp.* | +++ | ++ | + | ++ |
| *Chlorella spp.* | +++ | + | + | + |
| *Cadophora glomerata* | ++ | - | - | - |
| *Closterium spp* | +++ | ++ | - | ++ |
| *Gonatozygon* | ++ | ++ | - | + |
| *Glomerata* | ++ | +++ | - | ++ |
| *Spirogyra* | ++ | ++ | - | ++ |
| *Ulothrix zonata* | ++ | ++ | + | ++ |
| *Zygnema* | +++ | ++ | + | ++ |
| **Cyanophyceae** | | | | |
| *Anabaena spp.* | +++ | ++ | - | ++ |
| *Microcrosis spp.* | ++ | ++ | - | + |
| *Oscillatoria spp.* | +++ | ++ | - | ++ |
| *Phormidium spp.* | ++ | + | - | + |

+++ abundant; ++ present; + rare; - absent

**Table 3.** Correlation between hydrological attributes of the fluvial system of Rajaji National Park .

| | AT | WT | WC | Tu | HMD | Ta | Co | TDS | DO | F Co2 | pH | PO3 | NO3 | Chl | Alk | Na | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AT | 1 | | | | | | | | | | | | | | | | |
| WT | 0.804 | 1 | | | | | | | | | | | | | | | |
| WC | 0.520 | 0.476 | 1 | | | | | | | | | | | | | | |
| Tu | 0.676 | 0.605 | 0.681 | 1 | | | | | | | | | | | | | |
| HMD | 0.535 | 0.675 | 0.556 | 0.618 | 1 | | | | | | | | | | | | |
| Ta | 0.535 | 0.675 | 0.556 | 0.618 | 1.000 | 1 | | | | | | | | | | | |
| Co | 0.167 | -0.044 | 0.268 | 0.368 | 0.273 | 0.273 | 1 | | | | | | | | | | |
| TDS | 0.869 | 0.749 | 0.672 | 0.751 | 0.589 | 0.589 | 0.208 | 1 | | | | | | | | | |
| DO | -0.830 | -0.674 | -0.659 | -0.893 | -0.609 | -0.609 | -0.246 | -0.870 | 1 | | | | | | | | |
| F Co2 | 0.592 | 0.602 | 0.668 | 0.756 | 0.656 | 0.656 | 0.084 | 0.740 | -0.731 | 1 | | | | | | | |
| pH | 0.161 | 0.082 | -0.101 | 0.002 | -0.101 | -0.101 | -0.021 | -0.061 | -0.062 | -0.104 | 1 | | | | | | |
| PO3 | 0.199 | 0.542 | -0.029 | 0.165 | 0.235 | 0.235 | -0.333 | 0.101 | -0.137 | 0.135 | 0.374 | 1 | | | | | |
| NO3 | 0.094 | 0.146 | 0.171 | 0.185 | 0.561 | 0.561 | 0.352 | 0.162 | -0.167 | 0.270 | -0.350 | -0.170 | 1 | | | | |
| Chl | 0.115 | 0.368 | -0.179 | -0.194 | 0.025 | 0.025 | -0.504 | -0.020 | 0.113 | -0.175 | 0.044 | 0.396 | -0.218 | 1 | | | |
| Alk | 0.072 | -0.215 | 0.200 | 0.109 | -0.243 | -0.243 | 0.291 | 0.117 | -0.084 | 0.043 | 0.400 | -0.333 | -0.503 | -0.192 | 1 | | |
| Na | 0.530 | 0.350 | 0.573 | 0.565 | 0.359 | 0.359 | 0.146 | 0.576 | -0.661 | 0.511 | 0.128 | -0.074 | 0.158 | -0.269 | 0.146 | 1 | |
| K | 0.791 | 0.721 | 0.632 | 0.712 | 0.606 | 0.606 | 0.152 | 0.774 | -0.819 | 0.593 | 0.128 | 0.196 | 0.093 | 0.148 | 0.118 | 0.539 | 1 |

**Abbreviations :** A.T= Air temperature, W.T = Water temperature, W.C = Water Current, HMD = Hydro medium depth, Ta = Transparency, Tu = Turbidity, Co = Conductivity, TDS = Total Dissolved Solids, pH = Hydrogen Ion Concentration, D.O = Dissolved Oxygen, $F.CO_2$ = Free Carbon dioxide, $NO_2$ = Nitrates, $PO_3$ = Phosphates, Na = Sodium, K = Potassium

**Table 4.** Correlation between hydrological attributes and density of aquatic diversity dwelling in the fluvial system of Rajaji National Park.

| | Dn | AT | WT | WC | Tu | HMD | Ta | Co | TDS | DO | F Co2 | pH | PO3 | NO3 | Chl | Alk | Na | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dn | 1 | | | | | | | | | | | | | | | | | |
| AT | -0.894 | 1 | | | | | | | | | | | | | | | | |
| WT | -0.747 | 0.804 | 1 | | | | | | | | | | | | | | | |
| WC | -0.585 | 0.520 | 0.476 | 1 | | | | | | | | | | | | | | |
| Tu | -0.721 | 0.676 | 0.605 | 0.681 | 1 | | | | | | | | | | | | | |
| HMD | -0.683 | 0.535 | 0.675 | 0.556 | 0.618 | 1 | | | | | | | | | | | | |
| Ta | -0.683 | 0.535 | 0.675 | 0.556 | 0.618 | 1.000 | 1 | | | | | | | | | | | |
| Co | -0.340 | 0.167 | -0.044 | 0.268 | 0.368 | 0.273 | 0.273 | 1 | | | | | | | | | | |
| TDS | -0.880 | 0.869 | 0.749 | 0.672 | 0.751 | 0.589 | 0.589 | 0.208 | 1 | | | | | | | | | |
| DO | 0.868 | -0.830 | -0.674 | -0.659 | -0.893 | -0.609 | -0.609 | -0.246 | -0.870 | 1 | | | | | | | | |
| F Co2 | -0.624 | 0.592 | 0.602 | 0.668 | 0.756 | 0.656 | 0.656 | 0.084 | 0.740 | -0.731 | 1 | | | | | | | |
| pH | -0.098 | 0.161 | 0.082 | -0.101 | 0.002 | -0.101 | -0.101 | -0.021 | -0.061 | -0.062 | -0.104 | 1 | | | | | | |
| PO3 | -0.119 | 0.199 | 0.542 | -0.029 | 0.165 | 0.235 | 0.235 | -0.333 | 0.101 | -0.137 | 0.135 | 0.374 | 1 | | | | | |
| NO3 | -0.243 | 0.094 | 0.146 | 0.171 | 0.185 | 0.561 | 0.561 | 0.352 | 0.162 | -0.167 | 0.270 | -0.350 | -0.170 | 1 | | | | |
| Chl | -0.016 | 0.115 | 0.368 | -0.179 | -0.194 | 0.025 | 0.025 | -0.504 | -0.020 | 0.113 | -0.175 | 0.044 | 0.396 | -0.218 | 1 | | | |
| Alk | -0.086 | 0.072 | -0.215 | 0.200 | 0.109 | -0.243 | -0.243 | 0.291 | 0.117 | -0.084 | 0.043 | 0.400 | -0.333 | -0.503 | -0.192 | 1 | | |
| Na | -0.545 | 0.530 | 0.350 | 0.573 | 0.565 | 0.359 | 0.359 | 0.146 | 0.576 | -0.661 | 0.511 | 0.128 | -0.074 | 0.158 | -0.269 | 0.146 | 1 | |
| K | -0.767 | 0.791 | 0.721 | 0.632 | 0.712 | 0.606 | 0.606 | 0.152 | 0.774 | -0.819 | 0.593 | 0.128 | 0.196 | 0.093 | 0.148 | 0.118 | 0.539 | 1 |

**Abbreviations :** Den = density, A.T= Air temperature, W.T = Water temperature, W.C = Water Current, HMD = Hydro medium depth, Ta = Transparency, Tu = Turbidity, Co = Conductivity, TDS = Total Dissolved Solids, pH = Hydrogen Ion Concentration, D.O = Dissolved Oxygen, $F.CO_2$ = Free Carbon dioxide, $NO_2$ = Nitrates, $PO_3$ = Phosphates, Na = Sodium, K = Potassium

**Table 5.** Seasonal Variations in diversity indices of aquatic plants dwelling in the fluvial system of Rajaji National Park

| Season/Year | Winter | Summer | Monsoon | Autumn |
|---|---|---|---|---|
| **2001-2002** | **3.495±0.15** | 3.375±0.13 | **3.088±0.08** | 3.247±0.04 |
| **2002-2003** | **3.613±0.17** | 3.485±0.17 | **3.203±0.40** | 3.288±0.05 |

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# NEW RECORD OF MISTLETOE AS A POTENTIAL EXOTIC WEED: SERIOUS THREAT TO SAPOTA CULTIVATION IN CHHATTISGARH

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**Abstract :** *Dendrophthoe falcata* (L.f) Ettingsh commonly called "Banda" is a serious and very common angiospermic parasitic plant in Chhattisgarh it is being reported for the first time from sapota, *Achras sapota*. Our findings report that it was observed with an average plant population of 2.18 plants/trees and more number of the parasitic plant were observed on North and West direction, 2.60 and 2.40, respectively. *D. falcata* is the serious serious threat to sapota cultivation in Chhattisgarh. Insect pest associated with *D. falcate* were also recoded viz., *Celypha woodiana* (Barrett), *Pseudaulacaspis cockerelli* (Cooley), *Aleurodicus disperses* (Russell), *Delias hyparete metarete* (Linnaeus), *Euthalia adonia pinwilli, Papilio cresphontes, Frankliniella sp.*, Unidentified Chrysomelid along with natural enemies viz., *Oecophylla smaragdina* (Fabricius) *Cotesia flevipes*, *Oxyopes macilentus* (Linnaeus).

**Keywords :** Exotic weed, Cultivation, New record, Chhattisgarh

## INTRODUCTION

Sapota, *Achras sapota* L. is one of the prominent fruits and belongs to family sapotaceae. Sapota is a delicious fruit crop of tropical and subtropical countries which are a good source of sugar, carbohydrates, protein, fat, calcium, phosphorus, iron and ascorbic acid. They are used for making jams, jellies, osmodehydrated slices and squash. Sapota orchards cover approximately 160,000 hectares area all over the country. In Chhattisgarh, it covers about 220 hactare areas under cultivation and yielding 748.5 metric tons of fruits, as reported by the National Horticulture Board (Anonymous, 2012). Various factors their which affect the yield of Sapota, among them insect pests and parasitic plants are important.

Parasitic plant was first reported on sapota in 2014 at Horticultural orchard, T. C. B. College of Agriculture and Research Station, Sarkanda, Bilaspur, (Chhattisgarh). It was identified as *Dendrophthoe falcata* (L.f) Ettingsh as one of the hemiparasitic plants that belong to the *Loranthaceae* family of mistletoes on sapota tree. It is commonly known as Banda, Banda Patha, Vrksadani and Bemdram. It is the most common of all the mistletoes that occur in India. At present reports say that it has around 401 host plants. *Dendrophthoe falcata* represents the only known mistletoe with the largest global host range (Calvin and Wilson, 2009). It is unwanted and emerges out from branch of sapota remaining active throughout the year. It gets attached to the cambium of sapota plant. Leaves of mistletoe are broad, leathery, waxy and light green in colour. Seed dispersal and pollination is usually mediated by the birds (Hambali, 1977). They attach themselves to the branch of sapota with the help of galls present at the base. Due to infestation of this plant, there is reduction in number of buds, flowers and fruits. Infested plants can be easily recognized due to the presence of red flowers conspicuous from a distance (Plate 1). It is one of the major constraints of establishment of sapota orchards in Chhattisgarh.

## MATERIAL AND METHOD

The present studies on the parasitic plant, *D. falcata* (L.f) Ettingsh were conducted at the Horticultural orchard of TCB College of Agriculture and Research Station, Bilaspur, Chhattisgarh, India, during 2013-14. Observations were recorded on the number of parasitic plants at four directions viz. North, South, East and West on randomly selected ten trees of sapota (*cv* kalipatti). Each plant was also examined to record the live stages of insects and their nature of damages along with different natural enemies. The immature stages of the insects recorded on the parasitic plants were collected and reared to adult stage in the laboratory of Department of Entomology. The species were later on got identified from different sources.

## RESULT AND DISCUSSION

### Association of mistletoe, *Dendrophthoe falcata* (L.f) Ettingsh with sapota

From the data presented in Table 1 it was observed that on an average plant population of 2.18 plants/trees was recorded and more number of the parasitic plant were observed on North and West direction, 2.60 and 2.40, respectively. Observations, on the incidence of parasitic on sapota, revealed that the maximum plants of sapota are affected with various number of mistletoe in sapota agro-ecosystem. The results indicate that the *D. falcata* is the serious problem of sapota in Chhattisgarh.

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**Record of insect pests and their natural enemies on mistletoe, *Dendrophthoe falcate***

During the experiment eight insects were recorded on parasitic plants viz. Marble moth, *Celypha woodiana* (Barrett), False oleanderscale, *Pseudaulacaspis cockerelli* (Cooley), Spiralling whitefly, *Aleurodicus disperses* (Russell), Painted Jezebel butterfly, *Delias hyparete metarete* (Linnaeus), Green Baron, *Euthalia adonia pinwilli*, Giant swallowtail caterpillar, *Papilio cresphontes*, Thrips, *Frankliniella sp.*, Unidentified Chrysomelid and few natural enemies were also observed associated with above mentioned insect pests viz., Red ant, *Oecophylla smaragdina* (Fabricius), Apenteles, *Cotesia flevipes* and Lynx Spider, *Oxyopes macilentus* (Linnaeus).

**Table 1.** Number of misteltoe/plants of Sapota, *Achras sapota* L.

| S.No. | North | South | East | West | Mean |
|---|---|---|---|---|---|
| 1 | 3 | 0 | 3 | 1 | **1.75** |
| 2 | 4 | 2 | 0 | 0 | **1.50** |
| 3 | 2 | 1 | 3 | 2 | **2.0** |
| 4 | 1 | 0 | 4 | 1 | **1.50** |
| 5 | 3 | 0 | 1 | 5 | **2.25** |
| 6 | 0 | 4 | 5 | 1 | **2.50** |
| 7 | 5 | 2 | 1 | 4 | **3.0** |
| 8 | 2 | 1 | 0 | 2 | **1.25** |
| 9 | 0 | 5 | 0 | 6 | **2.75** |
| 10 | 6 | 3 | 2 | 2 | **3.25** |
| **Mean** | **2.60** | **1.80** | **1.90** | **2.40** | **2.18** |

**Table 2.** Record of insect pests of mistletoe, *Dendrophthoe falcate*

| S.N. | Insect pests | Scientific Name | Order | Family |
|---|---|---|---|---|
| 1 | Marble moth | *Celypha woodiana* Barrett | Lepidoptera | Tortricidae |
| 2 | False oleanderscale | *Pseudaulacaspis cockerelli Cooley* | Hemiptera | Diaspididae |
| 3 | Spiralling whitefly | *Aleurodicus disperses* Russell | Hemiptera | Aleyrodidae |
| 4 | Painted Jezebel butterfly | *Delias hyparete metarete* Linnaeus | Lepidoptera | Pieridae |
| 5 | Green Baron | *Euthalia adonia pinwilli* | Lepidoptera | Nymphalidae |
| 6 | Giant swallowtail caterpillar | *Papilio cresphontes* | Lepidoptera | Papilionidae |
| 7 | Thrips | *Frankliniella sp.* | Thysenoptera | Thripidae |
| 8 | Chrysomelid beetle | Unidentified | Coleoptera | Chrysomelidae |
| **Natural enemies :** | | | | |
| 1 | Red ant | *Oecophylla smaragdina* Fabricius | Hymenoptera | Formicidae |
| 2 | Apenteles | *Cotesia flevipes* | Hymenoptera | Braconidea |
| 3 | Lynx Spider | *Oxyopes macilentus* L. | Araneae | Araneidae |

Plate 1. Mistletoe, *Dendrophthoe falcate* along with flowers associated with sapota

Plate 2. Cluster of mistletoe fruits

Plate 3. Initial stage of mistletoe on sapota

Plate 4. *Aleurodicus dispersus* on mistletoe leaves

Plate 5. *Delias hyparete metarete* feed on mistletoe

Plate 6. *Cotesia flevipes* a larval parasitoid of *Celypha*

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# CONSTRAINTS AND STRATEGIES IN ADOPTION OF BEEKEEPING BY BEEKEEPING ENTREPRENEURS

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**Abstract :** The study was conducted in Six block of Samastipur district in Bihar out of twenty block six block selected namely Pusa, Kalyanpur, Ujiarpur, Warisnagar, Marwa and sarairanjan. A sample of 90 trained beekeeping entrepreneurs were selected from six experimental village and 90 untrained beekeeping entrepreneurs were from other six control villages in order to avoid interactional and diffusion effect. Thus a total sample of 180 rural entrepreneurs was selected as respondents. Constraints faced by beekeeping entrepreneurs in setting up beekeeping enterprise were grouped in four categories viz. socio - personal, economic, technological and communicational constraints. Low level of consumer awareness and motivation, poor access to finance, irregular and ineffective training programme for upgrading the know-how and skill and inadequate access to training programme were the major constraints for beekeeping entrepreneurship development. The following strategies are suggested not only to remove the bottlenecks rationed above but also to strengthen the adoption of beekeeping enterprise by entrepreneurs were creation of proper consumer awareness for enhancing motivation provision of institutional finance on reasonable interest improving access and effectiveness of training programme in beekeeping enterprise.

**Keywords :** Constraints analysis, Strategies, Beekeeping entrepreneurs, Effectiveness of training programme

## INTRODUCTION

Apiculture is an ideal absorbing instructive and economically profitable hobby. It is especially suitable for women because it does not involve heavy physical work, allows time flexibility, provides gainful employment near to their house and ultimately provides financial security. It solves problem of unemployment if adopted on Commercial scale or as cottage industry. It can generate self employment to over 15 million rural and tribal families and can produce annual income of over Rs 4.5 billion by producing 150000 tons of honey (Shende, 1992)India is in a peculiar situation where poverty is not only acute but a chronic malady even in the presence of abundant natural resources prevalence of chronic unemployment, under employment, poor quality of human capital in adequacy of skills to meet the Social Problems, Superstitions, Social taboos, Low level of technology, Poor economic organizations are some of the maladies the country is facing. In the present solution after division of Bihar the state economy needs to be given more attention and only choice left with the state is to put concentrated effort toward development of small scale enterprise. Thus, the country is looking forward for more and more entrepreneurs to build a strong national economy.

Many such studies have been carried out in the past in different parts of the country Mishra and Gary 1998, Nigam 1995, Rammanna 1999, Shende 1992, Singh and Patel 2010 but there exists a dearth of literature about constraints perceived by rural people in adoption of beekeeping enterprise particularly in extent of Bihar. The present study is an attempt to bridge the gap in information with the adjective of analyzing constraints perceived by the rural people in adoption of beekeeping enterprise to identity the strategies for faster development of beekeeping enterprise.

## METHODOLOGY

The present study was conducted in six block of Samastipur district in Bihar. Out of twenty block namlely Pusa, kalyanpur, Ujiarpur, Warisnagar, Marwa and Sarairanjan were selected. Further two villages from each block making by random sampling technique. A sample of 90 trained beekeeping entrepreneur were selected from six experimental villages and untrained beekeeping entrepreneurs were from other six control village in order to avoid interactional and diffusion effect. Thus a total sample of 180 rural entrepreneurs was selected as respondents. A well structured interview schedule for identification of constraints was administered. The data collected through interview were tabulated and analyzed using simple statistical tools.

## RESULT AND DISCUSSION

In the present study constraints include Socio-personal, economic, technological and communicational constraints were presented in table 1.

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**Socio-personal constraints-** Analysis that data of socio- personal constraints, low level of consumer`s awareness and motivation was the most important constraint express by majority of the entrepreneurs (86.66%) got Rank I, lack of pertinent knowledge about new innovation (82.22%) got Rank II, Low level of education (76.66%) got Rank III, poor investment due to poor saving (77.22%), lack of marginal capabilities (72.77%), fear of failure (69.44%), dominance of male in decision making process (66.11%) and rest of important constraints faced from 20 to 55 percent by the beekeeping entrepreneurs.

**Table 1.** Constraints encountered by beekeeping entrepreneurs.

| SL. No. | Constraints | Beekeeping entrepreneurs (n=180) | | Rank |
|---|---|---|---|---|
| | | Frequency | Percentage | |
| **A** | **Socio-personal Constraints** | | | |
| 1 | Low level of Consumer awareness and motivation | 156 | 86.66 | I |
| 2 | Lack of managerial capabilities | 131 | 72.77 | V |
| 3 | Low level of Education | 138 | 76.66 | III |
| 4 | Dominance of male in decision making process | 119 | 66.11 | VII |
| 5 | Poor investment due to poor saving | 139 | 77.22 | IV |
| 6 | Lack of family support | 90 | 50.00 | IX |
| 7 | Negative Social attitudes | 59 | 32.77 | XI |
| 8 | Problem of more Competition | 76 | 42.22 | X |
| 9 | Pear of failure | 125 | 69.44 | VI |
| 10 | Lack of pertinent knowledge about new innovation | 148 | 82.22 | II |
| 11 | Low exposure to business, hence less experience | 44 | 24.44 | XII |
| 12 | Social custom and traditions | 99 | 55.00 | VIII |
| **B** | **Economic Constraints** | | | |
| 1 | Difficult and costly maintenance management of beekeeping practices | 86 | 47.77 | IV |
| 2 | Involvement of middleman in getting loan from bank | 62 | 34.44 | VI |
| 3 | Poor access to finance | 160 | 88.88 | I |
| 4 | Non-availability of loan facilities for the purchase of inputs | 143 | 79.44 | II |
| 5 | High price of honey bee colonies | 121 | 67.22 | III |
| 6 | Lack of government/NGOs support | 69 | 38.33 | V |
| **C** | **Technological Constraints** | | | |
| 1 | The means of Common people | 123 | 68.33 | III |
| 2 | Lack of adequate knowledge of seasonal management related to beekeeping practices | 57 | 31.66 | VII |
| 3 | Lack of knowledge about disease and pest management | 88 | 48.88 | V |
| 4 | Lack of know-how about the importance of artificial diet as stimulating feeding | 52 | 28.88 | VIII |
| 5 | Poor access to input | 141 | 78.33 | II |
| 6 | Difficulty in main training honey bee colonies during death period and also during extreme low high temperature | 74 | 41.11 | VI |
| 7 | Irregular and in effective training programme for upgrading the know-how and skill related to beekeeping practices | 169 | 93.88 | I |
| 8 | Lack of scientific processing storage and marketing facility of honey and other honey products | 101 | 56.11 | IV |
| **D** | **Communicational Constraints** | | | |
| 1 | Poor rapport to extension agencies | 73 | 40.55 | III |
| 2 | Inadequate access to training programme | 159 | 88.33 | I |
| 3 | Poor infrastructure particularly transport and Communication facilities | 111 | 61.66 | II |
| 4 | Low Social mobility of rural women | 65 | 36.11 | IV |

**Economic Constraints-** Poor access to finance was the major economic problem expressed by the most of the entrepreneurs (88.88%) got Rank I, Non availability of loan facilities for the purchase of input (79.44%) got Rank II, high price of honey bee colonies (67.67%), Difficult and costly maintenance management of beekeeping practices (47.77%), lack of government/Ngo support (38.33%) and

involvement of middleman in getting loan from bank (34.44%) got last rank were also constraints in establishing beekeeping enterprises.

**Technological Constraints-** From perusal of table 1 it evident that the technological constraints were left by most of the entrepreneurs irregular and ineffective training programme for upgrading the knowhow and skill related to beekeeping enterprise was observed as major technical constraints since it was expressed by majority of the entrepreneurs (93.88%) followed by poor access to input (78.33%) and technology (68.33%) got rank III and rest got the rank IV to VIII in different technological Constraints.

**Communicational Constraints-** Under the Communicational constraints inadequate access to training programme (88.33%) got the rank I was found as major constraints. Poor infrastructure particularly transport and communication facilities (61.66%) poor rapport to extension agencies (44.55%) and low social mobility of rural women (36.11%) got last rank IV were also the important constraint (Table 1)

**Strategies**

Constraints which prevent beekeeping entrepreneurs in starting self employment necessitate the need to design development strategies. The following strategies are suggested not only to remove the bottlenecks mentioned above but also to strengthen the adoption of beekeeping enterprise by entrepreneurs strategies suggested by respondents for development of entrepreneurship among rural people should address all these aspects.

**Socio-personal strategies-** Table 2 revealed that under the socio personal strategies creation of proper consumers awareness for enhancing motivation was the major Socio- personal strategies expressed by most of the entrepreneurs (93.88%) got rank I followed by easy access to new innovation (83.88%) improvement educational facilities (76.66%) got rank III. This could be made possible through effective entrepreneurial training. There is need to create more awareness and interest among the people about the benefits of beekeeping enterprise and they should be motivated to adopt modern practices. There is need to diversify honeybee products to different valuable and nutritive substances which could also be used as recreation and employment generating activity for rural youths and women.

**Economic strategies-** Out of four economic strategies perceived by entrepreneurs the most important was provision of institutional finance on reasonable interest and easy terms (88.66%). The other strategies perceived by the entrepreneurs in order of their importance in descending order were increasing access to various inputs on subsidized basis (71.66%) loan should be made available to the entrepreneurs at low rates of interest and tax exemption be extended to this enterprise (49.44%). However, loan, grants and subsidies should be linked directly with entrepreneurs (without involvement of middle man) as the present loan delivery system has failed to each many entrepreneurs.

Grants and subsidies provided by the government under different schemes for beekeeping enterprise also are made publicly known to avoid misappropriation or favoritism in disbursement of these funds. The present policy of subsidies needs to be reviewed; the subsidy should be linked with the performance since the existing pattern has failed to raise beekeeping entrepreneurs (Table 2).

**Table 2.** Strategies for accelerating the adoption of beekeeping enterprise by beekeeping entrepreneurs.

| Sl. No. | Strategies | Beekeeping entrepreneurs (n=180) | | Rank |
|---|---|---|---|---|
| | | Frequency | Percentage | |
| **A** | **Socio-personal Strategies** | | | |
| 1 | Access to new innovation | 151 | 83.88 | II |
| 2 | Improving managerial capabilities | 123 | 68.33 | IV |
| 3 | Improvement in educational facilities | 138 | 76.66 | III |
| 4 | Creation of proper consumers awareness for enhancing motivation | 169 | 93.88 | I |
| **B** | **Economic Strategies** | | | |
| 1 | Loans, grant and subsidies should be linked directly with beekeeping entrepreneurs as the present loan delivery system has failed to reach many beekeeping entrepreneurs | 67 | 37.22 | IV |
| 2 | Provision of institutional Finance on reasonable interest and easy terms. | 156 | 86.66 | I |
| 3 | Increasing access to various inputs on subsidized basis | 129 | 73.66 | II |
| 4 | Loan should be made available to the beekeeping entrepreneur low rates of interest and tax exemption be extended to this enterprise | 89 | 49.44 | III |
| **C** | **Technological Strategies** | | | |
| 1 | Generation of simple and cost effective technologies | 128 | 71.11 | III |
| 2 | Enhancing access to scientific and improved inputs | 140 | 77.77 | II |

| | | | | |
|---|---|---|---|---|
| 3 | Improving access to regular and effective training programme for upgrading the know-how and skill | 163 | 90.55 | I |
| 4 | Development of scientific processing storage and marketing facility of honey and other honey products | 102 | 56.66 | IV |
| **D** | **Communicational Strategies** | | | |
| 1 | Improving infrastructure particularly transport and communication facilities | 132 | 73.33 | II |
| 2 | Increasing social mobility of rural women | 77 | 42.77 | IV |
| 3 | Increasing rapport of rural people to extension agencies | 96 | 53.33 | III |
| 4 | Effective participation of rural people in training programme | 175 | 97.22 | I |

**Technological Strategies-** Regarding technical strategies, improving access to regular and effective training programme for upgrading the knowhow and skill was the most important strategy expressed by majority of respondents (90.55%) got rank I followed by enhancing access to scientific and improved inputs (77.77%) and generation of Simple and cost effective technologies (71.11%). It is a fact that there was lack of regular and effective training for up gradation of technical know-how and skill related to scientific beekeeping enterprise. Therefore adequate manpower is developed so that we may have trained field workers in beekeeping enterprise at village, block, tehsil and district levels. Graded training should be imparted in different organizations. The government, NGOs and educational institutions should come forward to popularize beekeeping enterprises through integrating effective training mass-media and financial assistance. The necessary arrangement should be made to provide various scientific and improved inputs to entrepreneurs at reasonable cost.

**Communicational Strategies-** The results depicted in table 2 that effective participation of rural people in training programmes was the most important communication strategy expressed by majority of the respondents (97.22%) got rank I followed by improving infrastructure particularly transport and communication facilities (73.33%) got rank II. The other strategies of importance were increasing rapport of rural people to extension agencies (53.33%) and increasing social mobility of rural women (42.77%).

## CONCLUSION

There is needs create more awareness and interest in beekeeping enterprise. People engaged in traditional practices are motivated to adopt modern practices by organizing regular and proper training programme and providing technical guidance. Therefore adequate skilled manpower and trained field workers should be developed for improving the knowledge and up gradation of skills of entrepreneurs at village, block and district levels.

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# STUDY ON COMPARATIVE PERFORMANCE OF FINE SLENDER RICE GENOTYPES AGAINST RICE GALL MIDGE IN THE NORTHERN HILL REGION OF C.G.

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**Abstracts :** A part from food, rice is intimately involved in the culture as well as economy of many societies. The cultivation of rice is done under more diverse conditions than any other food crop, ranging from irrigated to rainfed ecology and upland to deep water conditions. In world, rice has occupied an area of 154 million hectares, with a total production of 476 million tonnes and productivity 2949 kg $ha^{-1}$ (Anonymous, 2012). India has largest area among rice growing countries and enjoys the second rank in production. India has 45.5 million hectares, total cultivated area under rice, with the production of 105.31 million tonnes and productivity 2393 kg $ha^{-1}$ (Anonymous, 2013 a). Chhattisgarh state is popularly known as "rice bowl of India" because maximum area is covered under rice during *Kharif* and contribute major share in national rice production. It has geographical area of 13.51 million hectares of which 5.9 million hectares area is under cultivation. Rice occupies an area around 3.61 million hectares, with the production of 5.48 million tonnes and productivity 1517 kg $ha^{-1}$ (Anonymous, 2013b).

**Keywords :** Hill region, Genotypes, Rice

## INTRODUCTION

The productivity of rice in Chhattisgarh is comparatively lower than the national average. This is due to several constraints which are responsible for such low productivity rice in the region. Among these, insect pests are one of the most important factors limiting the rice production. There are more than 100 species of insect pests of rice but only about 20 of them are of major economic importance (Pathak and Khush, 1979). The losses due to insect pests during vegetative phase (50 percentage) contributes more to yield reduction than the reproductive phase (30 percentage) or ripening phase (20 percentage) as reported by Gupta and Raghuraman (2003). In Chhattisgarh region various rice pests cause losses up to 20 percentages every year to rice crop. Which gall midge, *Orseolia oryzae* (Wood-Mason), The Asian rice gall midge, *Orseolia oryzae* (Wood-Mason), Diptera: Cecidomyidae, is the most important pest and causes extensive damage. (Jagadeesha Kumar *et. al.*, 2009). It is an important pest from the seed bed to maximum tillering stages of the rice crop. Yield loss assessments in field with up to 30% tiller infestation suggest that for each 1% increase in tiller infestation, a farmer can expect to lose 2-3% grain yield, (Nacro *et al*., 1996). In Chhattisgarh rice gall midge is locally called "gangai". The extent of losses it cause has been recorded from as low as a few kilograms to as high as 25 q/ha (Kittur and Agrawal, 1983). The major active period of these insect is September to October. In rice gall midge, maggot is the destructive stage and the feeding maggot causes the conversion of leaf sheath to galls often referred as 'onion shoots' or 'silvershoots' (Hidaka, 1974 and Hill, 1987) and it also causes the production of secondary tillers which may themselves become infested. In India, gall midge is a serious pest of irrigated and shallow water rice ecosystem (Lai *et al*., 1984). In Chhattisgarh region gall midge caused 30 to 40 per cent losses in yield in susceptible varieties of paddy (Anonymous, 2010).

Therefore, **"**study on comparative performance of fine slender rice genotypes against rice gall midge in the northern region of C, G.**"** is undertaken for the present investigation

## MATERIAL AND METHOD

### Site and Climate

Ambikapur is an important rice growing tract of Chhattisgarh and comes under the northern hill region of Chhattishgarh in India. The general climate condition of Surguja is Eastern plateau and hilly region with average rainfall 1422.8 mm.

**Experimental details**

| | | |
|---|---|---|
| Place of experiment | : | Ajirma Research Farm RMD CARS, Ambikapur. |
| Crop | : | Rice |
| Date of sowing | : | 11-07-2013 |
| Date of transplanting | : | 01-08-2013 |
| Season | : | Kharif, 2013 |
| Design | : | Randomized Block Design |
| Replications | : | 03 |

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No. of entries : 60
Plot size : 4.5m x 0.8m
Spacing : 20 x 15 cm
Fertilizer dose : 100:50:30 Kg/ha.

**Table 1.** Rice genotype for screening.

| S. No | Designation | Cross combination | S. No. | Designation | Cross combination |
|---|---|---|---|---|---|
| **1** | Chandrahasini | (Check) | 22 | R 1625-1211-2-765-1 | Denteshwari / Tarori Basmati |
| **2** | IET 21053 (NDR9542) | (Check) | 23 | R 1629-112-2-67-1 | HMT x Jira Shankar |
| **3** | Indira Sona | (Check) | 24 | R 1630-1237-2-827-1 | SR 12 / Laxmi Bhog |
| **4** | Indira Sugandhit Dhan-1 | (Check) | 25 | R 1630-32-1-21-1 | IR 71703-221-1-5-2 x Laxmibhog |
| **5** | IR 83376 B-B110-3 | (Check) | 26 | R 1648-2663-2-2862-1 | R 1072-360-1-1 x Poornima |
| **6** | IR 64 | (Check) | 27 | R 1656-2821-1-3245-1 | Swarna x Jira Shankar |
| **7** | IR 84887-B-15 | MLT 11-24 | 28 | R 1656-3173-1-415-1 | Danteshwari x Elaychi |
| **8** | Mahisugandha | (Check) | 29 | R 1656-430-10-1965-1 | Swarna x Jira Shankar |
| **9** | R 1519-815-1-646-1 | Rastic Br 240-47 / Charder | 30 | R 1656-46-2-41-1 | Swarna x Jira Shankar |
| **10** | R 1521-950-6-843-1 | R 1521-950-6-843-1 | 31 | R 1661-1372-1-601-1 | R 1004-5552-1-1 x Nagri Dubraj |
| **11** | R 1536-1170-5-140-1 | R302-111 / Ganga Baru | 32 | R 1661-605-84-1 | R 1004-5552-1-1 x Nagri Dubraj |
| **12** | R 1536-136-1-77-1 | R 1536-136-1-77-1 | 33 | R 1664-59-1-46-1 | R 1004-5552-1-1 x Swarna |
| **13** | R 1545-184-3-22-1 | Pusa Basmati x Chinni Kapoor | **34** | R 1664-59-2-47-1 | R 1004-5552-1-1 x Swarna |
| **14** | R 1553-1369-2-252-1 | Mahamya / Nidhee | **35** | R 1667-1032-1-98-1 | R 1060-1674-1-1 x Chandrahasini |
| **15** | R 1588-7-1-1-1 | R 1102-2795-3 x Nidhee | **36** | R 1670-1151-1-119-1 | Samleshwari x Poornima |
| **16** | R 1595-14-1-6-1 | Pusa Basmati x Chini Kapoor | **37** | R 1670-3975-1-485-1 | Samleshwari x Poornima |
| **17** | R 1595-17-1-8-1 | Pusa Basmati x Chini Kapoor | **38** | R 1675-1844-2-1257-1 | R 1037-649-1-1 x Mahamaya |
| **18** | R 1595-17-3-10-1 | Pusa Basmati x Chini Kapoor | **39** | R 1688-2150-5-2060-1 | R 975-897-1-1 x Tarori Basmati |
| **19** | R 1599-594-2-305-1 | MTU 1010 x Mahamaya | **40** | R 1695-2155-1-270-1 | Danteshwari x Poornima |
| **20** | R 1607-28-3-19-1 | IR 71703-221-1-5-2 x Jira Shankar | **41** | R 1698-168-1-76-1 | Danteshwari x Elaychi |
| **21** | R 1607-321-1-34-1 | SR 12 x Chinni Kapoor | **42** | R 1698-3644-3-4696-1 | Danteshwari x Elaychi |
| **S. No** | **Designation** | **Cross combination** | **S. No.** | **Designation** | **Cross combination** |
| **43** | R 1700-2240-4-2295-1 | Danteshwari x Amrit Bhog | **52** | R 1819-469-2-137-1 | Shyamla x MR 219 |
| **44** | R 1700-302-1-156-1 | Denteshwari x Amrit Bhog | **53** | R 1819-473-1-139-1 | Shyamla x MR 219 |
| **45** | R 1730-501-3-250-1 | Poornima x Indira Sugandhit Dhan-1 | **54** | R 1926-1013-2-595-1 | R1130-80-1-52-1xHURFG 4-6 |
| **46** | R 1738-504-3-255-1 | IR 64x Pusa Basmati | **55** | R 1656-3181-1-420-1 | Swarna x Jira Shankar |
| **47** | R 1747-4941-1-515-1 | Rastic Br 240-47 x Shaym Jira | **56** | R 1938-620-1-163-1 | Abhaya x B 644-FMR-6-0-0 |
| **48** | R 1750-937-1-530-1 | BG380-2xAmrit Bhog | **57** | R1629-234-5-1882-2 | HMTx Jira Shankar |
| **49** | R 1757-540-3-286-1 | IR 64x Bishanu Bhog | **58** | R1700-308-3-170-1 | Denteshwari x Amrit Bhog |
| **50** | R 1779-320-1-111-1 | Danteshwari x WGL 320100 | **59** | TN 1 | (Check) |
| **51** | R 1804-399-1-134-1 | R 979-1528-2-1 x Gopal Bhog | **60** | Vishnu bhog | (Check) |

Sixty rice genotypes were screened against gall midge infestation based on the percentage of silver shoots. These varieties were sown on 11-07-2013 and were transplanted into the main field after 21 days. Regular crop practices were followed in the main field. When there was severe infestation of gall midge, observations like total number of plants, damaged plants, total number of tillers and total number of silver shoots were recorded. The observations for silver shoot appearance were taken at 30 and 50 days after transplanting (DAT). In each paddy genotypes, 10 plants were observed for silver shoots.

**Data processing**

Data were proceeding by following calculation of the silver shoots and standard evaluation system of gall midge damage.

$$\text{Percentage Silver shoots} = \frac{\text{Total number of silver shoots}}{\text{Total number of tillers}} \times 100$$

Observation of plants was taken on the basis of plant damage symptoms (0-9 scale).

**Table 2.** Standard evaluation systems for evaluating rice for resistant to gall midge (IRRI 2002)

| Score* | Rating | Damage percentage range (% SS) |
|---|---|---|
| 0 | Highly resistant | No damage |
| 1 | Resistant | 1-5 percent |
| 3 | Moderately resistant | 5-10 percent |
| 5 | Moderately susceptible | 10-15 percent |
| 7 | Susceptible | 15-25 percent |
| 9 | Highly susceptible | More than 25 percent |

*Mean score of plant damage was calculated.

The observations on pest incidence of gall midge were recorded at tillering stage and heading stage.

## RESULT AND DISCUSSION

### Rice Gall Midge (*Orseolia oryzae*) at 30 DAT

Sixty rice genotype were evaluated against rice gall midge, out of which twenty five were found free from gall midge infestation in fist group showed zero percentage infestation at 30 days after transplanting (DAT) viz. Chandrahasini, IET 21053 (NDR9542), , Indira Sugandhit Dhan-1, R 1521-950-6-843-1, R 1536-136-1-77-1, R 1553-1369-2-252-1, R 1588-7-1-1-1, R 1648-2663-2-2862-1, R 1664-59-1-46-1, R 1664-59-2-47-1, R 1675-1844-2-1257-1, R 1688-2150-5-2060-1, R 1698-168-1-76-1, R 1700-2240-4-2295-1, R 1700-302-1-156-1, R 1747-4941-1-515-1, R 1757-540-3-286-1, R 1779-320-1-111-1, R 1804-399-1-134-1, R 1926-1013-2-595-1, R 1938-620-1-163-1, R 1656-3181-1-420-1, R1629-234-5-1882-2, R1700-308-3-170-1and Indira Sona. In second group Vishnu bhog (ch) is showing significantly and independently minimum silver shoot percentage (1.10%). In third group ten genotype were found significantly at par they are designated with percent damage of rice gall midge as R 1625-1211-2-765-1(2.67%), R 1656-430-10-1965-1(2.72%), R 1738-504-3-255-1(2.83%), R 1661-1372-1-601-1(2.86%), R 1670-3975-1-485-1(2.90%), R 1661-605-84-1(2.94%), R 1630-32-1-21-1(3.02%), R 1656-46-2-41-1(3.24%), IR 83376 B-B110-3 (ch)(3.42%) and R 1545-184-3-22-1(3.45%). In fourth group twelve genotypes were found significantly similar with each other and showed silver shoot percent damage ranged from 3.61% to 4.51% These genotypes are R 1599-594-2-305-1(3.59%), R 1595-17-3-10-1(3.61%), R 1695-2155-1-270-1(3.63%), R 1595-14-1-6-1 (3.69%), R 1630-1237-2-827-1(3.76%), R 1667-1032-1-98-1(3.79%), IR 64(ch)(4.10%), R 1519-815-1-646-1(4.22%), IR 84887-B-15(4.23%), R 1819-473-1-139-1(4.41%), R 1607-28-3-19-1(4.45%), and R 1629-112-2-67-1(4.45%). In fifth group six genotypes were found significantly at par with each other namely; R 1607-321-1-34-1(4.49%), R 1595-17-1-8-1(4.53%), R 1819-469-2-137-1(4.53%), R 1536-1170-5-140-1(4.54%), R 1670-1151-1-119-1(4.55%) and R 1656-3173-1-415-1(5.00%). In sixth group five genotypes were found significantly at par are as given i.e. R 1730-501-3-250-1(5.43%), R 1750-937-1-530-1(6.46%), R 1698-3644-3-4696-1(5.67%), R 1656-2821-1-3245-1(5.69%) and Mahisugandha (5.87%). In seventh group only one entry i.e. susceptible (check) TN 1 showed maximum silver shoots percentage (7.25%) at 30 DAT. are significantly different from all the entries evaluated in the experiment.

### Rice Gall Midge (*Orseolia oryzae*) at 50 DAT

At 50 days after transplanting out of sixty genotypes twenty five were found free from rice gall midge infestation in first group showed zero percentage damage. These genotypes namly, Chandrahasini (ch.), IET 21053 (NDR9542) (ch.), Indira Sugandhit Dhan-1(ch), R 1521-950-6-843-1, R 1536-136-1-77-1, R 1553-1369-2-252-1, R 1588-7-1-1-1, R 1648-2663-2-2862-1, R 1664-59-1-46-1, R 1664-59-2-47-1, R 1675-1844-2-1257-1, R 1688-2150-5-2060-1, R 1698-168-1-76-1, R 1700-2240-4-2295-1, R 1700-302-1-156-1, R 1747-4941-1-515-1, R 1757-540-3-286-1, R 1779-320-1-111-1, R 1804-399-1-134-1, R 1926-1013-2-595-1, R 1938-620-1-163-1, R 1656-3181-1-420-1, R1629-234-5-1882-2, R1700-308-3-170-1 and Indira Sona (ch). In the second group Vishnu bhog (ch.) showed minimum silver shoots percentage (2.28%). which was significantly different from rest of the genotypes.In third group six entries were observed significantly at par viz. IR 83376 B-B110-3 (ch.) (7.71%), IR 64 (ch.) (7.42%) , R 1738-504-3-255-1(8.04%), R 1595-14-1-6-1(8.24%), R 1607-28-3-19-1(9.03%), R 1625-1211-2-765-1(9.08%) In fourth group nine entry were found significantly similar with each other namely, R 1656-430-10-1965-1(9.39%), R 1661-1372-1-601-1(9.84%) , IR 84887-B-15(9.91%) , R 1595-17-3-10-1(10.17%) , R 1656-46-2-41-1(10.78%) , R 1670-3975-1-485-1(9.78%) , R 1661-605-84-1(10.38%) ,R 1667-1032-1-98-1(10.79%) , R 1630-1237-2-827-1(11.25%) .

In fifth group eight entries were found significantly at par , they are designated with percent damage of rice gall midge as, R 1519-815-1-646-1(11.40%) , R

1595-17-1-8-1(11.40%), R 1629-112-2-67-1(11.88%) , R 1536-1170-5-140-1(11.98%) , R 1630-32-1-21-1(12.22%), R 1545-184-3-22-1(12.25%) , R 1599-594-2-305-1(12.87%) , and R 1670-1151-1-119-1(13.35%) . In sixth group eight entries were found significantly similar with each other i.e. R 1695-2155-1-270-1(14.93%), R 1730-501-3-250-1(15.37%), R 1607-321-1-34-1(15.77%), R 1698-3644-3-4696-1(15.81%), R 1819-469-2-137-1(16.19%), R 1656-3173-1-415-1(16.97%), R 1656-2821-1-3245-1(17.05%) and R 1819-473-1-139-1(17.58%). In seventh group three entries were found significantly at par with each other viz. Mahisugandha (Ch.) (18.29%), R 1750-937-1-530-1(20.07%) and TN 1 Susceptible (Ch.) (28.66%).

**Table 3.** Average percentage Silver Shoots at 30 Day After Transplanting.

| NO. | Name of Entry/genotypes | Parentage | Percentage silver shoots | Scale (0-9) | Reaction Pattern |
|---|---|---|---|---|---|
| **1** | Chandrahasini | (Check) | 0.00 (2.87) | 0 | HR |
| **2** | IET 21053 (NDR9542) | (Check) | 0.00 (2.87) | 0 | HR |
| **3** | Indira Sona | (Check) | 0.00 (2.87) | 0 | HR |
| **4** | Indira Sugandhit Dhan-1 | (Check) | 0.00 ((2.87) | 0 | HR |
| **5** | IR 83376 B-B110-3 | (Check) | 3.42 (10.52) | 3 | MR |
| **6** | IR 64 | (Check) | 4.10 (11.52) | 3 | MR |
| **7** | IR 84887-B-15 | MLT 11-24 | 4.23 (11.72) | 3 | MR |
| **8** | Mahisugandha | (Check) | 5.87 (13.97) | 5 | MS |
| **9** | R 1519-815-1-646-1 | Rastic Br 240-47 / Charder | 4.22 (11.77) | 3 | MR |
| **10** | R 1521-950-6-843-1 | R 1521-950-6-843-1 | 0.00 (2.87) | 0 | HR |
| **11** | R 1536-1170-5-140-1 | R302-111 / Ganga Baru | 4.54 (12.22) | 3 | MR |
| **12** | R 1536-136-1-77-1 | R 1536-136-1-77-1 | 0.00 (2.87) | 0 | HR |
| **13** | R 1545-184-3-22-1 | Pusa Basmati x ChinniKapoor | 3.45 (10.60) | 3 | MR |
| **14** | R 1553-1369-2-252-1 | Mahamya / Nidhee | 0.00 (2.87) | 0 | HR |
| **15** | R 1588-7-1-1-1 | R 1102-2795-3 x Nidhee | 0.00 ((2.87) | 0 | HR |
| **16** | R 1595-14-1-6-1 | Pusa Basmati x ChiniKapoor | 3.69 (10.99) | 3 | MR |
| **17** | R 1595-17-1-8-1 | Pusa Basmati x ChiniKapoor | 4.53 (12.23) | 3 | MR |
| **18** | R 1595-17-3-10-1 | Pusa Basmati x ChiniKapoor | 3.61 (10.82) | 3 | MR |
| **19** | R 1599-594-2-305-1 | MTU 1010 x Mahamaya | 3.59 (10.87) | 3 | MR |
| **20** | R 1607-28-3-19-1 | IR 71703-221-1-5-2 x Jira Shankar | 4.45 (12.05) | 3 | MR |
| **21** | R 1607-321-1-34-1 | SR 12 x ChinniKapoor | 4.49 (12.12) | 3 | MR |
| **22** | R 1625-1211-2-765-1 | Denteshwari / Tarori Basmati | 2.67 (9.32) | 3 | MR |
| **23** | R 1629-112-2-67-1 | HMT x Jira Shankar | 4.45 (12.08) | 3 | MR |
| **24** | R 1630-1237-2-827-1 | SR 12 / LaxmiBhog | 3.76 (11.12) | 3 | MR |
| **25** | R 1630-32-1-21-1 | IR 71703-221-1-5-2 x Laxmibhog | 3.02 (9.91) | 3 | MR |
| **26** | R 1648-2663-2-2862-1 | R 1072-360-1-1 x Poornima | 0.00 (2.87) | 0 | HR |
| **27** | R 1656-2821-1-3245-1 | Swarna x Jira Shankar | 5.69 (13.71) | 5 | MS |
| **28** | R 1656-3173-1-415-1 | Danteshwari x Elaychi | 5.00 (12.83) | 3 | MR |
| **29** | R 1656-430-10-1965-1 | Swarna x Jira Shankar | 2.72 (9.39) | 3 | MR |
| **30** | R 1656-46-2-41-1 | Swarna x Jira Shankar | 3.24 (10.29) | 3 | MR |
| **31** | R 1661-1372-1-601-1 | R 1004-5552-1-1 x NagriDubraj | 2.86 (9.65) | 3 | MR |
| **32** | R 1661-605-84-1 | R 1004-5552-1-1 x NagriDubraj | 2.94 (9.76) | 3 | MR |
| **33** | R 1664-59-1-46-1 | R 1004-5552-1-1 x Swarna | 0.00 (2.87) | 0 | HR |
| **34** | R 1664-59-2-47-1 | R 1004-5552-1-1 x Swarna | 0.00 (2.87) | 0 | HR |
| **35** | R 1667-1032-1-98-1 | R 1060-1674-1-1 x Chandrahasini | 3.79 (11.13) | 3 | MR |
| **36** | R 1670-1151-1-119-1 | Samleshwari x Poornima | 4.55 (12.23) | 3 | MR |
| **37** | R 1670-3975-1-485-1 | Samleshwari x Poornima | 2.90 (9.74) | 3 | MR |
| **38** | R 1675-1844-2-1257-1 | R 1037-649-1-1 x Mahamaya | 0.00 (2.87) | 0 | HR |
| **39** | R 1688-2150-5-2060-1 | R 975-897-1-1 x Tarori Basmati | 0.00 (2.87) | 0 | HR |
| **40** | R 1695-2155-1-270-1 | Danteshwari x Poornima | 3.63 (10.89) | 3 | MR |
| **41** | R 1698-168-1-76-1 | Danteshwari x Elaychi | 0.00 (2.87) | 0 | HR |
| **42** | R 1698-3644-3-4696-1 | Danteshwari x Elaychi | 5.67 (13.72) | 5 | MS |
| **43** | R 1700-2240-4-2295-1 | Danteshwari x AmritBhog | 0.00 (2.87) | 0 | HR |
| **44** | R 1700-302-1-156-1 | Denteshwari x AmritBhog | 0.00 (2.87) | 0 | HR |
| **45** | R 1730-501-3-250-1 | Poornima x Indira Sugandhit Dhan-1 | 5.43 (13.42 | 5 | MS |
| **46** | R 1738-504-3-255-1 | IR 64x Pusa Basmati | 2.83 (9.61) | 3 | MR |
| **47** | R 1747-4941-1-515-1 | Rastic Br 240-47 x ShaymJira | 0.00 (2.87) | 0 | HR |
| **48** | R 1750-937-1-530-1 | BG380-2xAmrit Bhog | 6.46 (14.63) | 5 | MS |
| **49** | R 1757-540-3-286-1 | IR 64x BishanuBhog | 0.00 (2.87) | 0 | HR |
| **50** | R 1779-320-1-111-1 | Danteshwari x WGL 320100 | 0.00 (2.87) | 0 | HR |
| **51** | R 1804-399-1-134-1 | R 979-1528-2-1 x GopalBhog | 0.00 (2.87) | 0 | HR |
| **52** | R 1819-469-2-137-1 | Shyamla x MR 219 | 4.53 (12.16) | 3 | MR |
| **53** | R 1819-473-1-139-1 | Shyamla x MR 219 | 4.41 (12.04) | 3 | MR |
| **54** | R 1926-1013-2-595-1 | R1130-80-1-52-1xHURFG 4-6 | 0.00 (2.87) | 0 | HR |
| **55** | R 1656-3181-1-420-1 | SwarnaxJira Shankar | 0.00 (2.87) | 0 | HR |
| **56** | R 1938-620-1-163-1 | Abhaya x B 644-FMR-6-0-0 | 0.00 (2.87) | 0 | HR |
| **57** | R1629-234-5-1882-2 | HMTxJira Shankar | 0.00 (2.87) | 0 | HR |

| | | | | | |
|---|---|---|---|---|---|
| **58** | R1700-308-3-170-1 | Denteshwari x AmritBhog | 0.00 (2.87) | 0 | HR |
| **59** | TN 1 | Susceptible (Check) | 7.25 (15.56) | 5 | MS |
| **60** | Vishanubhog | (Check) | 1.10 (5.91) | 3 | MR |
| | **SEm±** | | **0.463** | | |
| | **CD (5%)** | | **1.298** | | |

Figures in parentheses are Angular transformed values.
DAT- Days after transplanting, SS- Silver shoot (tiller basis), Score= 0-Highly resistant (0% SS),2- Resistant (<1% SS), 3- Moderately resistant (1-5% SS), 5- Moderately susceptible (5-10%SS),7-Susceptible (10-25% SS), 9- Highly susceptible (25% SS).

**Table 4.** Average Percentage Silver Shoots at 30 Day after Transplanting (IRRI ratings)

| Scale (0-9) | Score (Silver shoot) | Category | Number of entries | Name of entries |
|---|---|---|---|---|
| 0 | No damage | Highly Resistant | 25 | Chandrahasini, IET 21053 (NDR9542), Indira Sugandhit Dhan-1, R 1521-950-6-843-1, R 1536-136-1-77-1, R 1553-1369-2-252-1, R 1588-7-1-1-1, R 1648-2663-2-2862-1, R 1664-59-1-46-1, R 1664-59-2-47-1, R 1675-1844-2-1257-1, R 1688-2150-5-2060-1, R 1698-168-1-76-1, R 1700-2240-4-2295-1, R 1700-302-1-156-1, R 1747-4941-1-515-1, R 1757-540-3-286-1, R 1779-320-1-111-1, R 1804-399-1-134-1, R 1926-1013-2-595-1, R 1656-3181-1-420-1, R 1938-620-1-163-1, R1629-234-5-1882-2, R1700-308-3-170-1,and Indira Sona. |
| 1 | Less than 1% | Resistant | 0 | -Nil- |
| 3 | 1-5% | Moderately Resistant | 28 | IR 83376 B-B110-3, IR 64, IR 84887-B-15, R 1519-815-1-646-1, R 1536-1170-5-140-1, R 1545-184-3-22-1, R 1595-14-1-6-1, R 1595-17-1-8-1, R 1595-17-3-10-1, R 1599-594-2-305-1, R 1607-28-3-19-1, R 1607-321-1-34-1, R 1625-1211-2-765-1, R 1629-112-2-67-1, R 1630-1237-2-827-1, R 1630-32-1-21-1, R 1656-430-10-1965-1, R 1656-46-2-41-1, R 1661-1372-1-601-1, R 1661-605-84-1, R 1667-1032-1-98-1, R 1670-1151-1-119-1, R 1670-3975-1-485-1, R 1695-2155-1-270-1, R 1738-504-3-255-1, R 1819-469-2-137-1, R 1819-473-1-139-1, Vishanubhog |
| 5 | 5-10% | Moderately Susceptible | 7 | Mahisugandha, R 1656-2821-1-3245-1,R 1656-3173-1-415-1, R 1698-3644-3-4696-1, R 1730-501-3-250-1, R 1750-937-1-530-1, TN 1, |
| 7 | 10-25% | Susceptible | 0 | -Nil- |
| 9 | More than 25% | Highly Susceptible | 0 | -Nil- |

**Table 5.** Average Percentage Silver Shoots at 50 Days after Transplanting

| NO. | Name of Entry | Parentage | Percentage Silver Shoots | Scale (0-9) | Reaction Pattern |
|---|---|---|---|---|---|
| **1** | Chandrahasini | (Check) | 0.00 (2.87) | 0 | HR |
| **2** | IET 21053 (NDR9542) | (Check) | 0.00 (2.87) | 0 | HR |
| **3** | Indira Sona | (Check) | 0.00 (2.87) | 0 | HR |
| **4** | Indira Sugandhit Dhan-1 | (Check) | 0.00 (2.87) | 0 | HR |
| **5** | IR 83376 B-B110-3 | (Check) | 7.71 (15.93) | 5 | MS |
| **6** | IR 64 | (Check) | 7.42 (15.76) | 5 | MS |
| **7** | IR 84887-B-15 | MLT 11-24 | 9.91 (18.28) | 5 | MS |
| **8** | Mahisugandha | (Check) | 18.29 (25.29) | 7 | S |
| **9** | R 1519-815-1-646-1 | Rastic Br 240-47 / Charder | 11.40 (19.66) | 7 | S |
| **10** | R 1521-950-6-843-1 | R 1521-950-6-843-1 | 0.00 (2.87) | 0 | HR |
| **11** | R 1536-1170-5-140-1 | R302-111 / Ganga Baru | 11.98 (20.18) | 7 | S |
| **12** | R 1536-136-1-77-1 | R 1536-136-1-77-1 | 0.00 (2.87) | 0 | HR |
| **13** | R 1545-184-3-22-1 | Pusa Basmati x Chinni Kapoor | 12.25 (19.86) | 7 | S |
| **14** | R 1553-1369-2-252-1 | Mahamya / Nidhee | 0.00 (2.87) | 0 | HR |
| **15** | R 1588-7-1-1-1 | R 1102-2795-3 x Nidhee | 0.00 (2.87) | 0 | HR |
| **16** | R 1595-14-1-6-1 | Pusa Basmati x Chini Kapoor | 8.24 (16.61) | 5 | MS |
| **17** | R 1595-17-1-8-1 | Pusa Basmati x Chini Kapoor | 11.40 (19.68) | 7 | S |
| **18** | R 1595-17-3-10-1 | Pusa Basmati x Chini Kapoor | 10.17 (18.52) | 7 | S |
| **19** | R 1599-594-2-305-1 | MTU 1010 x Mahamaya | 12.87 (20.93) | 7 | S |
| **20** | R 1607-28-3-19-1 | IR 71703-221-1-5-2 x Jira Shankar | 9.03 (17.38) | 5 | MS |
| **21** | R 1607-321-1-34-1 | SR 12 x ChinniKapoor | 15.77 (23.36) | 7 | S |
| **22** | R 1625-1211-2-765-1 | Denteshwari / Tarori Basmati | 9.08 (17.46) | 5 | MS |
| **23** | R 1629-112-2-67-1 | HMT x Jira Shankar | 11.88 (20.10) | 7 | S |
| **24** | R 1630-1237-2-827-1 | SR 12 / LaxmiBhog | 11.25 (19.56) | 7 | S |
| **25** | R 1630-32-1-21-1 | IR 71703-221-1-5-2 x Laxmibhog | 12.22 (20.40) | 7 | S |
| **26** | R 1648-2663-2-2862-1 | R 1072-360-1-1 x Poornima | 0.00 (2.87) | 0 | HR |

| | | | | | |
|---|---|---|---|---|---|
| **27** | R 1656-2821-1-3245-1 | Swarna x Jira Shankar | 17.05 (24.33) | 7 | S |
| **28** | R 1656-3173-1-415-1 | Danteshwari x Elaychi | 16.97 (24.27) | 7 | S |
| **29** | R 1656-430-10-1965-1 | Swarna x Jira Shankar | 9.39 (17.81) | 5 | MS |
| **30** | R 1656-46-2-41-1 | Swarna x Jira Shankar | 10.78 (19.09) | 7 | S |
| **31** | R 1661-1372-1-601-1 | R 1004-5552-1-1 x NagriDubraj | 9.84 (18.21) | 5 | MS |
| **32** | R 1661-605-84-1 | R 1004-5552-1-1 x NagriDubraj | 10.38 (18.72) | 7 | S |
| **33** | R 1664-59-1-46-1 | R 1004-5552-1-1 x Swarna | 0.00 (2.87) | 0 | HR |
| **34** | R 1664-59-2-47-1 | R 1004-5552-1-1 x Swarna | 0.00 (2.87) | 0 | HR |
| **35** | R 1667-1032-1-98-1 | R 1060-1674-1-1 x Chandrahasini | 10.79 (19.04) | 7 | S |
| **36** | R 1670-1151-1-119-1 | Samleshwari x Poornima | 13.35 (21.35) | 7 | S |
| **37** | R 1670-3975-1-485-1 | Samleshwari x Poornima | 9.78 (18.13) | 5 | MS |
| **38** | R 1675-1844-2-1257-1 | R 1037-649-1-1 x Mahamaya | 0.00 (2.87) | 0 | HR |
| **39** | R 1688-2150-5-2060-1 | R 975-897-1-1 x Tarori Basmati | 0.00 (2.87) | 0 | HR |
| **40** | R 1695-2155-1-270-1 | Danteshwari x Poornima | 14.93 (22.69) | 7 | S |
| **41** | R 1698-168-1-76-1 | Danteshwari x Elaychi | 0.00 (2.87) | 0 | HR |
| **42** | R 1698-3644-3-4696-1 | Danteshwari x Elaychi | 15.81 (23.38) | 7 | S |
| **43** | R 1700-2240-4-2295-1 | Danteshwari x AmritBhog | 0.00 (2.87) | 0 | HR |
| **44** | R 1700-302-1-156-1 | Denteshwari x AmritBhog | 0.00 (2.87) | 0 | HR |
| **45** | R 1730-501-3-250-1 | Poornima x Indira Sugandhit Dhan-1 | 15.37 (23.05) | 7 | S |
| **46** | R 1738-504-3-255-1 | IR 64x Pusa Basmati | 8.04 (17.10) | 5 | MS |
| **47** | R 1747-4941-1-515-1 | Rastic Br 240-47 x ShaymJira | 0.00 (2.87) | 0 | HR |
| **48** | R 1750-937-1-530-1 | BG380-2xAmrit Bhog | 20.07 (26.56) | 7 | S |
| **49** | R 1757-540-3-286-1 | IR 64x BishanuBhog | 0.00 (2.87) | 0 | HR |
| **50** | R 1779-320-1-111-1 | Danteshwari x WGL 320100 | 0.00 (2.87) | 0 | HR |
| **51** | R 1804-399-1-134-1 | R 979-1528-2-1 x GopalBhog | 0.00 (2.87) | 0 | HR |
| **52** | R 1819-469-2-137-1 | Shyamla x MR 219 | 16.19 (23.70) | 7 | S |
| **53** | R 1819-473-1-139-1 | Shyamla x MR 219 | 17.58 (24.90) | 7 | S |
| **54** | R 1926-1013-2-595-1 | R1130-80-1-52-1xHURFG 4-6 | 0.00 (2.87) | 0 | HR |
| **55** | R 1656-3181-1-420-1 | SwarnaxJira Shankar | 0.00 (2.87) | 0 | HR |
| **56** | R 1938-620-1-163-1 | Abhaya x B 644-FMR-6-0-0 | 0.00 (2.87) | 0 | HR |
| **57** | R1629-234-5-1882-2 | HMTxJira Shankar | 0.00 (2.87) | 0 | HR |
| **58** | R1700-308-3-170-1 | Denteshwari x AmritBhog | 0.00 (2.87) | 0 | HR |
| **59** | TN 1 | Susceptible (Check) | 28.66 (23.22) | 9 | HS |
| **60** | Vishanubhog | (Check) | 2.28 (8.39) | 3 | MR |
| | **SEm±** | | **0.634** | | |
| | **CD (5%)** | | **1.778** | | |

Figures in parentheses are Angular transformed values.
DAT- Days after transplanting, SS- Silver shoot (tiller basis), Score= 0-Highly resistant (0% SS),2- Resistant (<1% SS), 3- Moderately resistant (1-5% SS), 5- Moderately susceptible (5-10%SS),7-Susceptible (10-25% SS), 9- Highly susceptible (25% SS).

## CONCLUSION

The present investigation indicate that on the basis of reaction pattern scale (0-9), twenty five genotypes/ varieties infestation range were found zero percentage highly resistant , Non were found resistant twenty eight were found moderately resistant and seven were found in the category of moderately susceptible at 30 days after transplanting. Whereas at 50 days after transplanting similar findings were recorded in genotypes category of highly resistant and moderately resistant ,but in the category of moderately susceptible ten genotypes were grouped while in susceptible category thirteen genotypes were found ,they shows the increasing percent damage in this category. However in highly susceptible check i.e. TN 1 recorded (Table no.4.1.3 and 4.1.4) thus against rice gall midge out of sixty genotypes of fine slender type could be utilized. Similar result to this were reported by Several workers kandalkar *et al*.,1991, Bentur et al.,1994, Bentur et al.,2003,Hussain and Bora.,1996,Meher et al.,2009,Mukherjee et al.,1996,Ogah et al., 2012,Rahman *et al.*, 1991, Rao *et al.*, 2002, Rao and Kandalkar, 1992, Sahu *et al.*, 1996, Saroja *et al.*, 1992, Setty *et al.*, 1994, Tan *et al.*, 1993, Tomar and Prasad, 1992.

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# INCIDENCE OF WHITE BACKED PLANT HOPPER, *SOGATELLA FURCIFERA* (HORVATH), ZIGZAG LEAF HOPPER, *RECILIA DORSALIS* AND WHITE LEAF HOPPER, *COFANA* SPP. UNDER UPLAND RICE ECOSYSTEM AND THEIR CORRELATION WITH WEATHER PARAMETERS

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**Abstract:** Rice occupies the prominent place in Indian agriculture. Field experiment was conducted at research farm of Indira Gandhi Krishi Vishwa Vidyalaya, Raipur during *kharif* season 2013-14 using two upland direct seeded rice ecosystems (UDS) and upland transplanted rice ecosystems (UTP). The results of field experiments revealed that the maximum incidence of white backed plant hopper, *Sogatella furcifera* and zigzag leaf hopper, *Recilia dorsalis* observed in UTP with (1.38) and (1.46) as compare to UDS with (0.20) and (0.32) nymph/adult/25 sweeps (seasonal mean), respectively. White backed plant hopper showed significant positive correlation with sun shine hours in UDS only. Zigzag leaf hopper showed significant positive correlation with sun shine hours and significant negative correlation with minimum temperature, average temperature, evening relative humidity, average relative humidity in UTP. The maximum population of white leaf hopper, *Cofana* spp. was observed in UDS as compare to UTP and showed non-significant correlation with weather parameters.

**Keywords**: Ecosystem, Leaf hopper, Plant hopper, Rice, Upland

## INTRODUCTION

Rice occupies the prominent place in Indian agriculture. It is the most important staple food crop of the developing world of more than 3 billion people. 'Rice is life'! This has become a worldwide mantra since the International Year of Rice in 2004 (Uphoff, 2011). About 90 percent of world rice is produced and consumed in Asia (Anonymous, 2004). Rice fields are very important because they are environmental buffers, they are a dynamic ecosystem that helps balance temperature and wind, and it provides a moderating effect on the surroundings (Rogel, 2004). A rice field undergoes three major ecological phases; aquatic, semi-aquatic and a terrestrial dry phase, during a single paddy cultivation cycle (Fernanado, 1995). Globaly rice agro ecosystems is categorized into five major types: (i) Irrigated rice fields (ii) rainfed rice fields (iii) Deep water rice fields, (iv) Upland rice fields, (v) Tidal water rice fields. In Chhattisgarh there are 5 agro-ecosystems in which rice is cultivated with different practices (Annonymous, 2009). Upland rice is usually grown in unfavourable soil and weather conditions and needs regular attention for obtaining good productivity. Insect pests menace is one among the many hurdles in reaching comprehensive rice grain productivity. The diversity of upland rice environments gives rise to a more heterogeneous insect fauna compared with the more homogeneous lowlands. Over 100 species of insect pests attack rice crop at various stages of its growth in India (Kalode and Pasalu, 1986). Rice plant hoppers are major pests across the country especially in irrigated rice. White backed plant hopper (WBPH), *Sogatella furcifera* Horvath (Hemiptera: Delphacidae) is economic importance because direct damage to crop by nymphs and adults sucking phloem sap and leading to hopper burn. White backed plant hopper, *Sogatella furcifera* Horvath is one of the most important rice pests (Watanabe, 1992). With the widespread introduction during the green revolution in the sixties and seventies of fertilizers, of improved varieties and of pesticides to rice crops, plant hoppers became important pests, most notably the white backed planthopper, *Sogatella furcifera* Horvath. White leaf hopper, *Cofana spectra* Distant (Hemiptera: Cicadellidae) damaged rice, sugarcane, wheat, sorghum, barley, grasses, etc. as a minor pest but some time serious pests. Zigzag leaf hopper, *Recilia. dorsalis* (Hemiptera: Cicadellidae) nymphs and adults excrete honeydew while feeding. Honeydew is attractive to ants because of its sugar content and may later be infected with sooty moulds. *R. dorsalis* can transmit rice tungro bacilliform virus, rice tungro spherical virus, rice dwarf virus and rice orange leaf virus. The aim of this study was to determine the incidence of Delphacidae and Cicadellidae in rice field between the developments stages of rice and it is relation with the weather factors. It is hoped that the findings from the study can contribute to the more ecological precise ways in dealing with outbreaks and control of insect pests of rice.

## MATERIAL AND METHOD

The populations of rice white backed plant hopper, *Sogatella furcifera* (Horvath), Zigzag leaf hopper,

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*Recilia dorsalis* and white leaf hopper, *Cofana* spp. were recorded through sweeping net in both upland transplanted rice ecosystem (UTP) and upland direct seeded rice ecosystem (UDS. A specification of sweep net is 30 cm diameter and 65cm depth. Sampling was done randomly four places by 25 sweep of rice field in morning at weekly interval. The observations on occurrence of plant and leaf hopper were recorded by taking total 4 samples from 4 locations in both ecosystems. All samples were collected near the center of the ecosystem at least 5 meter from the edge in order to reduce edge effects. Weekly collections were calculated for determining the population dynamics of plant and leaf hopper. Correlation analysis was carried out between field incidence of plant hopper, leaf hopper and weather parameters during *kharif* season 2013-14. Regression analysis was worked out as per method given by Gomez and Gomez, (1985).

## RESULT AND DISCUSSION

### Population dynamics of White backed plant hopper, *Sogatella furcifera* (Horvath)

White backed plant hopper, *Sogatella furcifera* was initiated on the rice crop during 2nd week of September with 1.00 adult/25 sweeps and reached to maximum with 1.25 adult/25 sweeps during 3rd week of October in upland direct seeded rice ecosystem (UDS while in the upland transplanted rice ecosystem (UTP) pests first noticed on rice crop during 2nd week of September with 0.50 adult/25 sweeps and maximum during 4th week of October with 8.75 adult/25 sweeps. In this experiment maximum incidence (based on seasonal mean) of white backed plant hopper, *Sogatella furcifera* observed in UTP with 1.38 nymph/adult/25 sweeps as compare to UDS with 0.20 nymph/adult/25 sweeps (Table 1 and fig1). These finding are in conformity with Reddy *et al.,* (1983), Rajendra (2009) and Garg (2012) reported that the *S. furcifera* appeared 2nd fortnight of September and highest during October to November. Ngoan (1972) reported that the sudden decline of WBPH at the later part of the growth stage may be attributed to the loss of succulence in the plant as crop moved towards senescence. On the contrary, Rajendra (2009) reported that the *S. furcifera* incidence highest in drill sown as compared to upghat transplanted rainfed paddy ecosystem.

### Population dynamics of Zigzag leaf hopper, *Recilia dorsalis*

First appearance of zigzag leaf hopper, *Recilia dorsalis* was observed 37 SMW in month of September with 0.25 nymph/adult/25 sweeps and maximum during 43 SMW in month of October with of 2.25 nymph/adult/25 sweeps in upland direct seeded rice ecosystem (UDS) whereas in the upland transplanted rice ecosystem (UTP) pests appeared during 1st week (36 SMW) of September with 0.25 nymph/adult/25 sweeps and remain up to crop harvesting. There was an increase in population in subsequent weeks and the maximum *R. dorsalis* population was recorded in last week (44 SMW) of October with 12.75 nymph/adult/25 sweeps. Incidence of zigzag leaf hopper, *Recilia dorsalis* was highest in UTP (1.46 seasonal mean) as compare to UDS (0.32 seasonal mean) during *kharif* season (Table 1and fig1). The present finding corroborates with Pathak and Khan (1994) who reported the seasonal occurrence varies distinctly in rice fields between areas where the insects undergo dormancy and diapause on the one hand, and where they remain active year-round on the other and *Nilaparvata lugens* and *Recilia dorsalis* become more prevalent during later stages. On the contrary, Nath and Bhagabati (1998) reported that the first appearance of zigzag leafhopper, *R. dorsalis* was slightly delayed in rice fields. The maximum numbers were recorded on 9th September during 1998 and 12th August during 1999 in Jorhat (India). The early disappearance of the zigzag leafhopper population might be due to maturity of the rice plant during October -November and the population might migrate to some other preferred hosts other than rice.

### Population dynamics of white leaf hopper, *Cofana* spp.

It is evident from the data (Table 1 and fig1) the adult population of white leaf hopper, *Cofana* spp. initiated during 34 SMW in month of August with 0.25 adult/25 sweeps and disappears after 37 SMW in month of September. The maximum population of *Cofana* spp. was observed on 36 SMW in month September with 0.75 adult/25 sweeps in upland direct seeded rice ecosystem (UDS) while in the upland transplanted rice ecosystem (UTP) pests papered from 2nd week (33 SMW) of August with 0.25 adult/25 sweeps and highest during 1st week (36 SMW) of September with a population of 0.50 adult/25 sweeps. The maximum seasonal mean population of white leaf hopper, *Cofana* spp. was observed in UDS as compare to UTP during *kharif* season 2013-14. These findings are in agreement with Oyediran and Heinrichs (1999) reported that the peak populations occur at 6 WAT (late tillering phase of crop growth) and the populations of *Cofana* species were higher in lowland than in upland fields. Gangurde (2004) reported that the higher *Cofona spectra* (Cicadellidae) was recorded during the tillering stage and milk stage of the crop in both insecticides treated and untreated irrigated rice production systems of the Philippines in a single season. Singh and Singh (2010) reported that the white rice leafhopper, *C. spectra* occurs in all rice fields but is most common in rainfed rice and it is minor pest.

**Correlation co-efficient between rice hopper and weather factors in upland rice ecosystem**

It was evident from the data (Table 2and fig 1) that the zigzag leaf hopper showed significant positive correlation with sun shine hours and significant negative correlation with minimum temperature, average temperature, evening relative humidity, average relative humidity except this showed non-significant negative correlation with maximum temperature and morning relative humidity in UPT while non significant correlation with all weather factors in UDS at 5 and 1 per cent level of significance. Except sun shine hours WBPH showed non- significant positive and negative correlation with weather parameter in both UDS and UTP. WBPH showed significant positive correlation with sun shine hours in UDS only. Population of white leaf hopper, *Cofona* spp. showed non-significant positive and negative correlation with weather factors in both ecosystems at 5 and 1 per cent level of significance. These findings are in agreement with Rajendra (2009) reported that the white backed plant hopper population showed negative relationship with maximum temperature and minimum temperature, whereas positive relationship with morning relative humidity in Upghat transplanted paddy ecosystem in Sirsi tulak, Karnataka. Narayansamy *et al.* (1979) reported that positive correlation with relative humidity.

## CONCLUSION

From the above study it can be concluded that the highest incidence of white backed plant hopper and zigzag leaf hopper was observed in upland transplanted rice ecosystem (UPT) as compare to upland direct seeded rice ecosystem (UDS) during October month but highest incidence of white leaf hopper observed in UDS as compare to UTP. This is probably due to the effects of biotic and abiotic factors. White backed plant hopper and Zigzag leaf hopper showed significant correlation with weather factors while white leaf hopper showed non-significant correlation with weather factors.

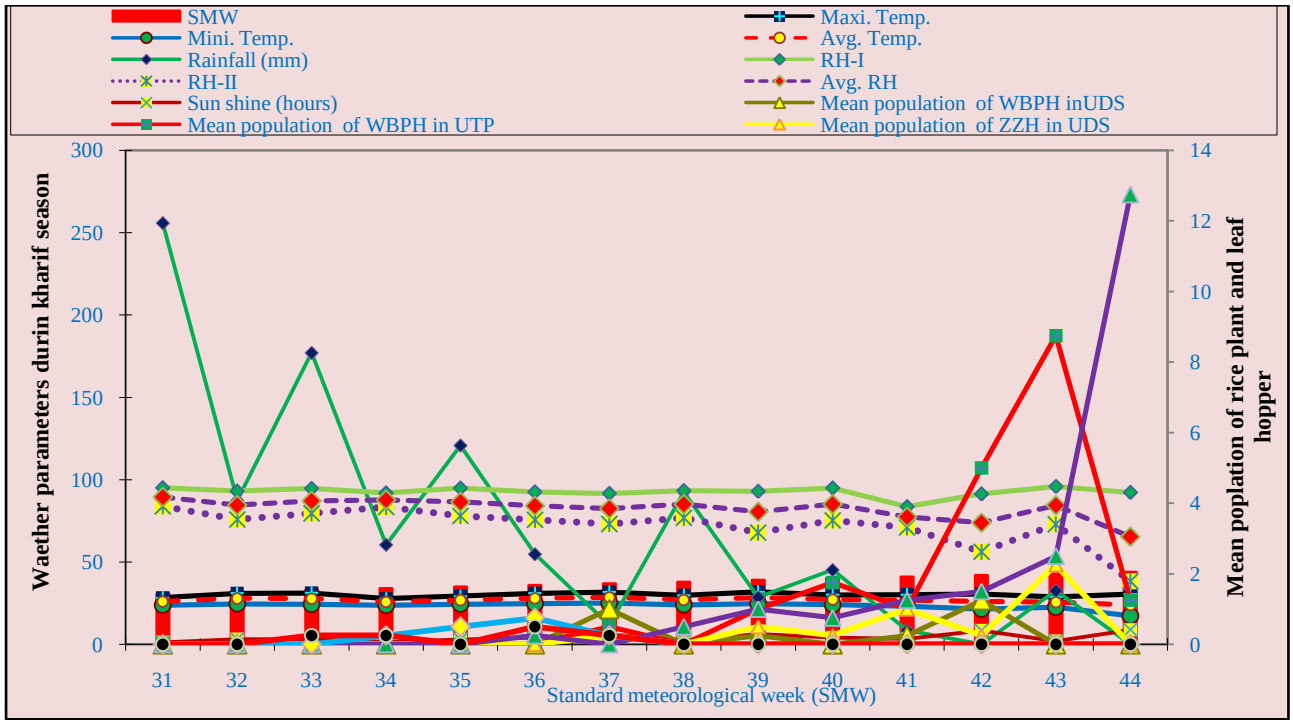


**Fig: 1.** Population fluctuation of rice white backed plant hopper, zigzag leaf hopper and white leaf hopper with Weather parameters.

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**Table 1.** Mean population of white backed plant hopper, zigzag leaf hopper and white leaf hopper in upland direct seeded and transplanted rice ecosystem

| *SMW | Upland direct seeded rice ecosystem | | | Upland transplanted rice ecosystem | | | Weather parameters | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Temperature ($^0$C) | | | Rainfall (mm) | Relative humidity (%) | | | Sun shine (hours) |
| | WBPH | ZZLH | WLH | WBPH | ZZLH | WLH | Maxi. Temp. | Mini. Temp. | Avg. Temp. | | Morn. | Even. | Avg. | |
| 31 | 0 | 0 | 0 | 0 | 0 | 0 | 28.30 | 23.90 | 26.10 | 255.80 | 95.10 | 83.90 | 89.50 | 1.30 |
| 32 | 0 | 0 | 0 | 0 | 0 | 0 | 31.10 | 24.70 | 27.90 | 87.40 | 93.10 | 76.00 | 84.55 | 3.30 |
| 33 | 0 | 0 | 0 | 0 | 0 | 0.25 | 31.30 | 24.40 | 27.85 | 177.00 | 94.70 | 79.60 | 87.15 | 3.30 |
| 34 | 0 | 0 | 0.25 | 0 | 0 | 0.25 | 27.80 | 23.80 | 25.80 | 60.50 | 92.00 | 83.60 | 87.80 | 1.50 |
| 35 | 0 | 0 | 0.5 | 0 | 0 | 0 | 29.30 | 24.50 | 26.90 | 120.80 | 94.90 | 78.10 | 86.50 | 3.10 |
| 36 | 0 | 0 | 0.75 | 0 | 0.25 | 0.5 | 31.10 | 24.80 | 27.95 | 54.80 | 92.60 | 75.70 | 84.15 | 4.20 |
| 37 | 1 | 0.25 | 0.25 | 0.5 | 0 | 0.25 | 31.90 | 25.20 | 28.55 | 11.60 | 91.70 | 73.30 | 82.50 | 6.20 |
| 38 | 0 | 0 | 0 | 0 | 0.5 | 0 | 29.90 | 24.10 | 27.00 | 92.60 | 93.40 | 76.90 | 85.15 | 2.50 |
| 39 | 0.25 | 0.5 | 0 | 1 | 1 | 0 | 32.00 | 24.90 | 28.45 | 28.60 | 93.00 | 68.00 | 80.50 | 6.30 |
| 40 | 0 | 0.25 | 0 | 1.75 | 0.75 | 0 | 30.10 | 24.20 | 27.15 | 45.20 | 95.00 | 75.30 | 85.15 | 4.20 |
| 41 | 0.25 | 1 | 0 | 1 | 1.25 | 0 | 30.20 | 23.30 | 26.75 | 8.60 | 83.70 | 71.10 | 77.40 | 3.50 |
| 42 | 1.25 | 0.25 | 0 | 5 | 1.5 | 0 | 30.70 | 21.40 | 26.05 | 0.00 | 91.40 | 56.30 | 73.85 | 8.60 |
| 43 | 0 | 2.25 | 0 | 8.75 | 2.5 | 0 | 28.80 | 22.60 | 25.70 | 32.60 | 95.90 | 73.10 | 84.50 | 2.10 |
| 44 | 0 | 0 | 0 | 1.25 | 12.75 | 0 | 30.50 | 17.30 | 23.90 | 0.00 | 92.30 | 38.40 | 65.35 | 8.90 |
| **S.M. | 0.20 | 0.32 | 0.13 | 1.38 | 1.46 | 0.09 | | | | | | | | |

*SMW= Standard meteorological week, **S.M. = Seasonal Mean, WBPH= white backed plant hopper, ZZLH= Zigzag leaf hopper, WLH = white leaf hopper.

**Table 2.** Correlation co-efficient (r) and Regression analysis between mean population of plant and leaf hopper with weather parameter in upland direct seeded and transplanted rice ecosystem

| **Correlation with** | | | **Correlation co-efficient (r)** | | **Regression equation value** | |
|---|---|---|---|---|---|---|
| **Weather parameter** | | **Rice pests** | **UDS** | **UTP** | **UDS** | **UTP** |
| Temperature($^0$C) | Maxi. Temp. | WBPH | 0.402 | -0.171 | y = 1.274x + 29.96 $R^2$ = 0.161 | y = -0.087x + 30.33 $R^2$ = 0.029 |
| | | ZZH | -0.172 | 0.046 | y = -0.354x + 30.32 $R^2$ = 0.029 | y = 0.017x + 30.18 $R^2$ = 0.002 |
| | | White hopper | 0.006 | 0.201 | y = 0.034x + 30.21 $R^2$ = 4E-05 | y = 1.632x + 30.06 $R^2$ = 0.040 |
| | Mini. Temp. | WBPH | -0.060 | -0.344 | y = -0.300x + 23.56 $R^2$ = 0.003 | y = -0.280x + 23.89 $R^2$ = 0.118 |
| | | ZZH | -0.089 | -0.927** | y = -0.293x + 23.60 $R^2$ = 0.008 | y = -0.569x + 24.34 $R^2$ = 0.858 |
| | | White hopper | 0.313 | 0.324 | y = 2.730x + 23.16 $R^2$ = 0.098 | y = 4.191x + 23.13 $R^2$ = 0.104 |
| | Average Temp. | WBPH | 0.155 | -0.362 | y = 0.486x + 26.76 $R^2$ = 0.024 | y = -0.184x + 27.11 $R^2$ = 0.130 |
| | | ZZH | -0.158 | -0.720** | y = -0.323x + 26.96 $R^2$ = 0.025 | y = -0.275x + 27.26 $R^2$ = 0.518 |
| | | White hopper | 0.254 | 0.361 | y = 1.382x + 26.68 $R^2$ = 0.064 | y = 2.912x + 26.60 $R^2$ = 0.130 |
| Rainfall (mm) | | WBPH | -0.439 | -0.389 | y = -79.50x + 85.29 $R^2$ = 0.192 | y = -11.39x + 85.34 $R^2$ = 0.151 |
| | | ZZH | -0.341 | -0.381 | y = -40.19x + 82.59 $R^2$ = 0.116 | y = -8.400x + 81.97 $R^2$ = 0.144 |
| | | White hopper | -0.011 | 0.017 | y = -3.356x + 70.09 $R^2$ = 0.000 | y = 7.906x + 68.97 $R^2$ = 0.000 |
| Relative humidity (%) | Morning | WBPH | -0.318 | 0.149 | y = -2.326x + 93.22 $R^2$ = 0.101 | y = 0.176x + 92.52 $R^2$ = 0.022 |
| | | ZZH | -0.082 | -0.073 | y = -0.390x + 92.89 $R^2$ = 0.006 | y = -0.065x + 92.86 $R^2$ = 0.005 |
| | | White hopper | 0.052 | -0.010 | y = 0.660x + 92.68 $R^2$ = 0.002 | y = -0.197x + 92.78 $R^2$ = 0.000 |
| | Evening | WBPH | -0.316 | -0.287 | y = -9.223x + 73.90 $R^2$ = 0.099 | y = -1.355x + 73.95 $R^2$ = 0.082 |
| | | ZZH | -0.038 | -0.876** | y = -0.715x + 72.32 $R^2$ = 0.001 | y = -3.117x + 76.65 $R^2$ = 0.766 |
| | | White hopper | 0.245 | 0.281 | y = 12.36x + 70.54 $R^2$ = 0.060 | y = 21.04x + 70.21 $R^2$ = 0.078 |
| | Average | WBPH | -0.365 | -0.230 | y = -5.775x + 83.56 $R^2$ = 0.133 | y = -0.589x + 83.24 $R^2$ = 0.052 |
| | | ZZH | -0.054 | -0.824** | y = -0.553x + 82.61 $R^2$ = 0.002 | y = -1.591x + 84.76 $R^2$ = 0.679 |
| | | White hopper | 0.238 | 0.256 | y = 6.513x + 81.61 $R^2$ = 0.056 | y = 10.42x + 81.50 $R^2$ = 0.065 |
| Sun shine (hours) | | WBPH | 0.611* | 0.147 | y = 3.637x + 3.499 $R^2$ = 0.373 | y = 0.141x + 4.019 $R^2$ = 0.021 |
| | | ZZH | -0.145 | 0.585* | y = -0.561x + 4.394 $R^2$ = 0.021 | y = 0.424x + 3.592 $R^2$ = 0.342 |
| | | White hopper | -0.101 | -0.084 | y = -1.043x + 4.344 $R^2$ = 0.010 | y = -1.282x + 4.328 $R^2$ = 0.007 |

*Significant at 5 % level (2.145), **Significant at 1 % level (2.977), UDS = Upland direct seeded rice ecosystem, UTP = Upland transplanted rice ecosystem

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# EVALUATION OF EFFICACY OF SOME NOVEL CHEMICAL INSECTICIDES AGAINST STEM BORER, *CHILO PARTELLUS* (SWINHOE) IN MAIZE

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**Abstract:** For present studies entitled "Evaluation of efficacy of some novel chemical insecticides against stem borer, *Chilo partellus* (Swinhoe) in maize", were conducted in randomized block design with three replications of seven treatments during *Kharif*, 2011 at crop research centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.). Among all the treatments the seed treatment with chlorantraniliprole 18.5 SC @4ml/kg seed and one spray @ 350ml/ha was performed best with minimum infestation (4.5 per cent at 25 DAS and 7.42 per cent at 40 DAS), minimum number of dead hearts (2.33 per cent at 25 DAS and 1.66 per cent at 40 DAS) and minimum tunnel length (1.94 cm). The second best treatment was found fipronil 5SC @ 4ml/kg seed and 625ml/ha with infestation (7.84 and 10.27 per cent at 25 and 40 DAS), dead hearts (2.66 per cent at 25 DAS and 2.33 per cent at 40 DAS) and tunnel length (2.41 cm). The maximum infestation (30.45 per cent at 25 DAS and 31.30 per cent at 40 DAS), maximum number of dead hearts (7.33 per cent 25 DAS and 6.33 per cent at 40 DAS) and maximum tunnel length (11.07 cm) per plant was recorded with untreated control during the study. The maximum grain yield of 73.33 q/ha and net profit of Rs. 32714/ha obtained from the treatment of chlorantraniliprole and followed by fipronil. The minimum grain yield of 37.78 q/ha was recorded in untreated control.

**Keywords:** Stem borer, Novel insecticides, Maize

## INTRODUCTION

Maize (*Zea mays)* is a plant belonging to the family of *gramineae*. It is cultivated globally being one of the most important cereal crops worldwide. Maize grain contains about 10 percent protein, 4 percent oil, 70 percent carbohydrate, 2-3 percent crude fiber, 10.4 percent albuminoids, 1.4 percent ash. Maize protein 'zein' is deficient in trypotophaneand lysine, the two essential amino acids. Maize grain has significant quantities of vitamin A, nicotinic acid, riboflavin and vitamin E. Maize is low in calcium, fairly high in phosphorus. Globally, maize is known as queen of cereals because it has the highest genetic yield potential among the cereals**.**

Maize is the third most important food grain in India after wheat and rice. In India, about 28% of maize produced is used for food purpose, about 11% as livestock feed, 48% as poultry feed, 12% in wet industry (for example starch and oil production) and 1% as seed (AICRP on Maize, 2007).

Insect-pests are the major factors responsible for low productivity of maize in India. The high yield in maize could not be released due to large number of insect pest attacking maize right sowing till harvest. Maize is attacked over 130 species of insect and pest of these four tissue borers viz. Maize stem borer, *Chilo partellus* (Swinhoe), Pink stem borer (*Sesamia inferens)*, Shoot fly (*Antherigona soccata*) and Asiatic Corn borer (*ostrinia furnacalis Guenes)* are regular and Serious pest for maize (Panwar (1995).

Potential losses due to insect pest on global basisis estimated to be in the order of 14-18%**.** Maize stem borer, *Chilo partellus* (Swinhoe) is a serious pest of maize (*Zea mays* L.) in India and distributed throughout the country.

Sarup *et. al.* (1978) worked out the economic threshold of *Chilo partellus* and reported the maximum reduction in yield and relatively higher damage between 10-20 day old crop, regard less of number of eggs released. The damaging stage of the pest is larvae. The freshly hatched caterpillars migrate towards the central shoot where they first feed on the tender leaves for sometimes. Later on they bore into top internodes and move downwards. In case of younger plants, the growing point and base of central whorl gets badly damaged resulting into the drying up to the central shoot. It is commonly known as 'dead heart'.

## METHOD AND MATERIAL

The present study was carried out at crop research centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.). Trails were conducted in randomized block design with three replications of seven treatments during *Kharif*, 2011. The maize variety 'DeKalb 900 M Gold' was sown with row to row distance of 60 cm and plant to plant distance was 15 cm and plots size 5 x 3 $mt^2$. The treatments for seed treatments included 6 novel insecticide formulations, viz. Thiamethoxam 25 FS@4g/kg, chlorantraniliprole18.5 SC @ 4ml/kg seed, Chloropyrephos 20 EC @ 4ml/kg seed, Fipronil 5 SC @ 4ml/kg seed, Imidacloprid 70 FS @ 4g/kg seed and Thiodicarb 75 WP @ 4g/kg seed. Observations were recorded on germination after 15 days of sowing. All the germinated plants per plot were counted and their percentage was calculated on

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the basis of total number of seed sown per plot. For recording the observation on stem borer infestations and dead hearts formation, three inner rows were used and other two rows were left to avoid border effect. All the plants showing infestation symptoms were counted plot wise and their percentages infestation was calculated on the basis of total plant stand. Infestation symptoms of stem borer damage or shoot holes in the three inner rows were counted first time at 25 DAS and second time at 40 DAS. The dead heart due to the attack of stem borer were counted from three inner rows, at 25 and 40 DAS and their percentage was calculated on the basis of total plants observed. Ten plants were uprooted at random from each plot at harvesting time. They were dissected and tunnel length was measured with the help of scale in centimeter. Percent stem tunneling was calculated on the bases of total tunneled length divided by plant height of affected plant. Average percent stem tunneling per plot was calculated by dividing total length by number of plants taken for tunneling observation. Population of lady bird beetles were recorded per plant at 15, 30 and 45 DAS on 5 randomly selected plants per plot.

## RESULT AND DISCUSSION

**Effect of different treatment on germination**

The data on the germination percent presented in table. that among all the treatments, there was no significant difference recorded in respect to the germination. The data on germination ranged from 93.33 to 82.02percent. The highest germination (93.33) was recorded with treatment of thiodicarb75 WP@ 4g/kg seed.

**Effect of different treatment on infestation of *Chilo Partellus* (Swinhoe)**

The results obtained on the percent infestation by maize stem borer was recorded at 25 and 40 DAS and are presented in table and shown in fig.

**Mean percent Infestation at 25 DAS**

The incidence of maize stem borer was recorded at 25 DAS is presented in table and fig. The results from the statistically analyzed data revealed that all the treatments checked borer infestation and proved significantly better than untreated control. The infestation at 25 DAS during 2011 ranged from 4.5 to 30.45 percent. The minimum infestation of 4.5 percent was found in plot treated with Chlorantraniliprole 18.5 SC@4ml/kg seed or 350ml/ha followed by fipronil5 SC@4ml/kg seed or 625 ml/ha with infestation of 7.84 percent. The treatments in next order to reduce the infestation of borer were thidicarb 75WP@4g/kg seed or 625 g/ha, thinmethoxam 25 FS@4g/kg seed or 250g/ha, Imidachloprid70 FS or 70 WG@4g/kg seed or 75g/ha, and Chloropyrephos 20EC @4ml/kg seed or 1 lit/ha with infestation of 8.19, 8.95, 9.17 and 11.07 percent, respectively. The maximum infestation of 30.45 percent was recorded in untreated control.

**Mean percent infestation at 40 DAS**

The results on mean percent infestation at 40 DAS presented in table and fig. The result from the statistically analyzed data revealed that all the treatments were found superior over untreated control. The infestation at 40 DAS ranged from 7.42 to 31.30 percent including untreated control. Among all the treatments, chlorantranilipralae18.5 Sc@4ml/kg seed or 350ml/ha was found best with minimum infestation of 7.42 percent and followed by fipronil 5Sc @4ml/kg seed or 625 ml/ha, Thiodicarb75wp@4g/kg seed or 625g/ha, Thiamethoxam 25 FS or 25 WG@ 4g/kg seed or 250g/ha, imidachloprid 70FS or 70WG @ 4g/kg seed or 75g/ha and Chloropyrephos 20EC @ 4ml/kg seed or 1lit/ha with infestation of 10.27, 10.82, 11.78, 12.79 and 13.07 percent, respectively. The maximum infestation of 31.30 percent was recorded with untreated control.

**Effect of different treatments on dead heart formation by stem borer, *Chilo partellus* (Swinhoe)**

To record the data on dead heart formation, observed from three inner rows in each plot. The dead hearts were counted at 25 and 40 DAS. The percentage of dead heart was calculated at 25 and 40 DAS on the basic of total observed plant.

**Dead hearts formation observation at 25 DAS**

The data on average number of dead hearts, ranged from 2.33 to 7.33 in different treatment including untreated control at 25 DAS. (table and fig.). All the treatments were found significantly superior as compared to untreated control. The minimum dead hearts (2.33) was found with treatment of chlorantranilipralae18.5 Sc @4ml/kg seed or 350 ml/ha and followed by Fipronil 5Sc@ 4ml/kg seed or 625ml/ha, thirodicarb75 wp@4g/kg seed or 625 g/ha, Thiamethoxam 25FS or 25wg@ 4g/kg seed or 250g/ha, imidachloprid 70FS or 70wg@4g/kg seed or 75g/ha and Chloropyrephos 20Ec@4ml/kg seed or 1 lit/ha with dead hearts of 2.66, 3.33, 4, 4.33 and 5 respectively. The maximum number of dead hearts (7.33) was recorded with untreated control.

**Dead hearts formation observation at 40 DAS**

The data presented in table and fig. on average number of dead hearts ranged from 1.66 to 6.33 in different treatments including untreated control at 25 DAS. All the treatments were found significantly superior as compare to untreated control. The minimum dead hearts (1.66) was found with treatment of chlorantranilipralae18.5 Sc@4ml/kg seed or 350 ml/ha and followed by fipronil 5 Sc@4ml/kg seed or 625ml/ha, thiodicarb 75wp@4g/kg seed or 625 g/ha, thiamethoxam 25Fs

or 25WG@ 4g/kg seed or 250 g/ha, imidachloprid 70 FS or 70WG@4g/kg seed or 75g/ha, Chloropyrephos 20EC@ 4ml/kg seed or 1 lit/ha with dead hearts of 2.33, 3, 3.33, 3.67 and 4.33 respectively. The maximum number of dead hearts (6.33) was recorded with untreated control.

**Effect of different treatments on stem tunneling by *Chilo partellus***

The average length of tunnel made by *Chilo partellus* (Swinhoe) in plant among different ranged from 1.94 to 4.92 cm per plant, while it was 11.07 cm in untreated control (Table and fig.). The shortest tunnel length (1.33cm) was found in chlorantrainliprale 18.5 sc@4ml/kg seed or 350 ml/ha and followed by fipronil 5sc@4ml/kg seed or 625ml/ha, Thiodicarb75wp@ 4g/kg seed or 625g/ha, thiamethoxam 25 Fs or 25 wg@ 4g/kg seed or 250g/ha, imidachloprid 70 Fs or 70wg@ 4g/kg seed or 75g/ha and Chloropyrephos 20EC@ 4ml/kg seed or 1 lit/ha with average tunnel length of 2.41, 3.37, 3.39, 4.53 and 4.92 cm per plant, respectively. The longest tunnel of 16.48 per plant was recorded in untreated control.

**Table 1.** Effect of different treatment on germination, infestation, dead heart formation, tunnel length of *chilo partellus (*Swinhoe*)* in maize during Kharif 2011.

| Treatment No. | Name of treatment | Dose | Germination (%) | Mean percent infestation | | Average No. of DH | | Average Stem tunnel (cm) |
|---|---|---|---|---|---|---|---|---|
| | | | | 25 DAS | 40 DAS | 25 DAS | 40 DAS | |
| $T_1$ | Thiamethoxam 25 FS | 4g/kg seed | 84.45 | 8.95 | 11.78 | 4 | 3.33 | 3.39 |
| $T_2$ | Chlorantraniliprole 18.5 SC | 4ml/kg seed | 87.28 | 4.5 | 7.42 | 2.33 | 1.66 | 1.94 |
| $T_3$ | Chlorpyriphos 20 EC | 4ml/kg seed | 82.84 | 11.07 | 13.07 | 5 | 4.33 | 4.92 |
| $T_4$ | Fipronil 5 SC | 4ml/kg seed | 82.02 | 7.84 | 10.27 | 2.66 | 2.33 | 2.41 |
| $T_5$ | Imidacloprid 75 FS | 4g/kg seed | 85.86 | 9.17 | 12.79 | 4.33 | 3.67 | 4.53 |
| $T_6$ | Thiodicarb75 WP | 4g/kg seed | 93.33 | 8.19 | 10.82 | 3.33 | 3 | 3.37 |
| $T_7$ | Control | - | 86.46 | 30.45 | 31.30 | 7.33 | 6.33 | 11.07 |
| **SEM ± CD at 5%** | | | **4.39 NS** | **0.922 2.871** | **1.079 3.36** | **0.79 2.45** | **0.41 1.26** | **0.25 0.78** |

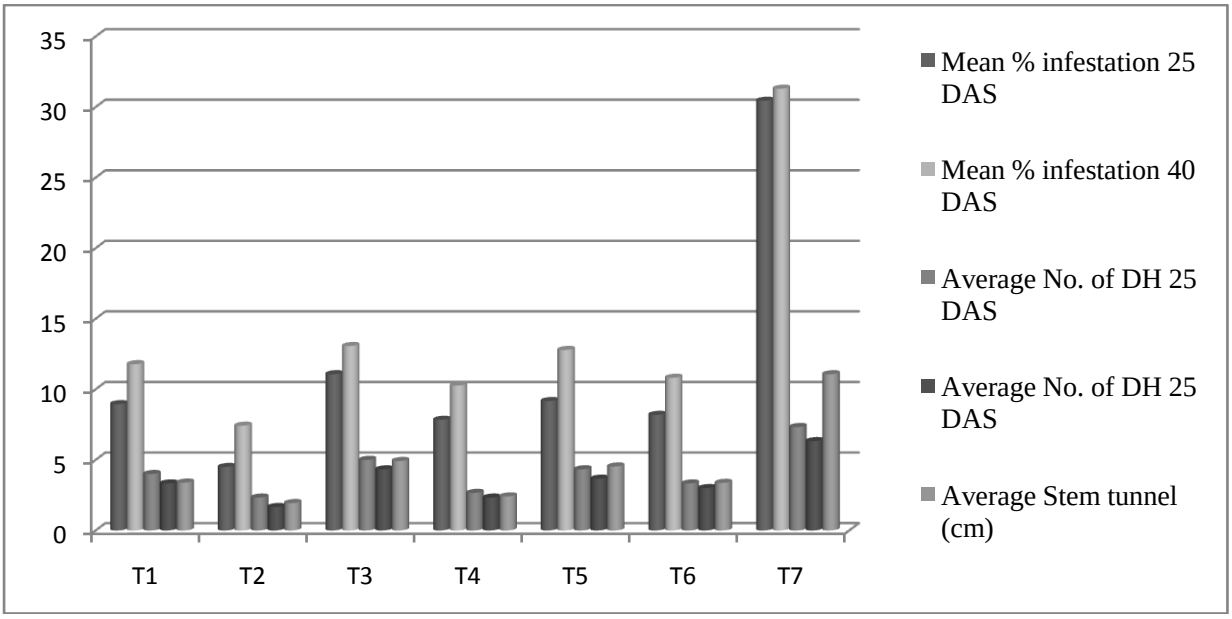


**Fig.** Effect of different treatment on infestation, dead heart formation, tunnel length of *chilo partellus (*Swinhoe*)* in maize during Kharif 2011.

## CONCLUSION

Among all the treatments chlorantraniliprole 18.5 SC@4ml/kg seed or 350ml/ha was performed best. The second best treatment was found fipronil 5SC@4ml/kg seed or 625ml/ha. The minimum number of dead hearts, minimum tunnel length, were found with the treatment of chlorantraniliprole 18.5 SC and next in order was the treatment of fipronil 5 during *kharif*, 2011. The maximum number of dead hearts was recorded with untreated control. followed by fipronil, thidicarb, thiameathoxam, imidacloprid, and Chloropyrephos. The minimum population of coccinellids (2.4, 3.13 and 3.87) was recorded in chlorantraniliprole 18.5 sc@4ml/kg seed or 350ml/ha. The highest population (14.68, 10.81 and 11.67) was recorded in untreated control.

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# SOIL QUALITY ASSESSMENT OF MILAK TAHSIL, DISTRICT RAMPUR (UTTAR PRADESH) UNDER RICE -MENTHA+WHEAT FARMING SYSTEM

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**Abstract :** Macro and micro nutrients are important soil elements that control its fertility. Soil fertility is one of the important factors controlling yields of the crops. Soil characterization in relation to evaluation of fertility status of soil of an area or region is an important aspect in context of sustainable agriculture production. Because of imbalanced and inadequate fertilizer use coupled with low efficiency of other inputs, the response efficiency of chemical fertilizer nutrients has declined tremendously under intensive agriculture in recent year. In the present investigation, an attempt has been made to examine the chemical properties of soil in rice – menthe+wheat farming system.The study area covers Milak Tehsil of Rampur district of Uttar Pradesh. Soil samples of 0-15 cm depth were collected from 326 sites covering 21 gram panchayats. Collected soil samples were air dried in shade, crushed gently with a wooden roller and pass through 2.0 mm sieve to obtain a uniform representative sample. The processed soil samples were analyzed by standard methods.The pH varied from 5.2 to 9.2, organic carbon content varied from 3.9 to 6.9 g $Kg^{-1}$ soil. The available N content was varied from 156.96 to 259.32 kg $ha^{-1}$ with an average value of 224.32 kg $ha^{-1}$ The available phosphorous content varied from 21.79 to 56.53 $P_2$ $O_5$ kg $ha^{-1}$ with a mean value of 37.18 $P_2O_5$ kg $ha^{-1}$.Status of available potassium in the ranged from 158.20 to 283.25 $K_2O$ Kg $ha^{-1}$ with an average value of 211.92 $K_2O$ kg $ha^{-1}$. Cu in the surface soil was found to sufficient and varied from 0.258 to 1.708 mg $kg^{-1}$ the iron content varied from 3.214 to 16.852, Mn from 1.701 to 8.351 mg $kg^{-1}$. The available Zn in surface (0-15 cm) in soil ranged from 0.425 to 1.708 mg $kg^{-1}$ soil in rice-mentha+wheat. Nutrient status regarding to the available macro and micro nutrient in surface soil indicate that soils are low in available N and medium in available P and K and in general marginal in available Cu,Fe, Mn and Zn. Normal to slightly alkaline in reaction, low to medium in organic carbon content.

**Keywords:** Soil fertility, Macro & micro nutrients, Rampur, Farming system

## INTRODUCTION

Agricultural production systems have been developed to meet the food, fibre and feed needs of the growing human population at the cost of natural ecosystem. Sustainable agriculture is a way of farming that integrates three primary objectives viz. environmental health, economic profitability, and social and economic equity. It is hoped that, over time, sustainable agriculture will i) meet human needs for food and fibre, ii) protect the natural resource base and prevent the degradation of soil and water quality, iii) use nonrenewable resources efficiently, iv) use natural biological cycles and controls, and v) assure the economic survival of farming and the well-being of farmers and their families.

With increasing demographic pressure coupled with scarcity of soil and water resources, sustainable agriculture is not synonymous with "low-input" or organic agriculture. In some cases, low-input system may be acceptable for a short time, but in others like major food grain crops it may not be acceptable at all. As there is no alternative to agricultural intensification in our country, we must ensure using soil resources as per their capability and adopting the practices that improve soil quality and maintain a favorable soil condition for plant growth and environmental health (Mishra, 2005)

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Use of high yielding varieties, intensive cropping, increase use of high analysis fertilizers and restricted use of organic sources of Nutrients has resulted in the deficiency of macro and micro nutrients in general particularly in the irrigated lands.(Ratan and Sharma 2004).Nutrient removed by crop depends on cultivar, soil moisture status, management levels and residue management. Macro and micro nutrients are important soil elements that control its fertility. Soil fertility is one of the important factors controlling yields of the crops. Soil characterization in relation to evaluation of fertility status of soil of an area or region is an important aspect in context of sustainable agriculture production. Because of imbalanced and inadequate fertilizer use coupled with low efficiency of other inputs, the response efficiency of chemical fertilizer nutrients has declined tremendously under intensive agriculture in recent year. Recent diagnostic survey indicate that in many intensively cultivated area farmers have resorted to use greater than recommended doses of fertilizer, especially N Fertilizer, to maintained the crop productivity at levels attained previously with relatively small fertilization rates. This is an indication of decline in factor productivity. Low fertility of India soil is the major constant in achieving high productivity goals. In both agriculturally advanced irrigated ecosystems, nutrient replenishment through fertilizers and manures remain

far below crop removal, thus causing the mining of native nutrient reserves over year. Wide spread deficiencies of macro and micro nutrients have emerged, and significant crop response to application of these nutrients are reported. The deficiencies are so intense and severe that visual symptoms are very often observed in major crops (Kumar *et al.*, 2013**).** The results of numerous field experiments in different parts of India have, therefore indicated *"Fertilizer-induced unsustainability of crop productivity"* (Yadav 2003). Variation in nutrient supply is a natural phenomenon and some of them may be sufficient where other deficient. The stagnation in crop productivity cannot be boosted without balanced and optimal dose of inorganic fertilizers use of organic such as farm yard manure, compost, green manure, crop residue incorporation use of industrial waste biofertilizer, N fixers both symbiotic and associate and p solubilizers. Variations in nutrient supply are a natural phenomena and some where may be sufficient while some where deficient. Within a soil, variability may exist depending upon the hydrological properties of the soil and cropping system therefore 21 locations will required different management practices to sustained crop productivity and for this full information about the nutrient status is important. Therefore to have sound information about the nutrient status of these soils this study was under taken.

## MATERIAL AND METHOD

The district Rampur is located between longitude 78-0-54 & 69-0-28 east and latitude 28-25 & 29-10 north. Spread in area of 2367 Sq Km. Falls in Moradabad division of Uttar Pradesh state. It is surrounded by district Udham singh Nagar in north, Bareilly in east, Moradabad in west and Badaun in south. The height from sea level is 1902 meter in north and 166.4 meter in south. The study area covers Milak Tehsil of Rampur district of Uttar Pradesh. Soil samples of 0-15 cm depth were collected from 326 sites covering 21 gram panchayats. Collected soil samples were air dried in shade, crushed gently with a wooden roller and pass through 2.0 mm sieve to obtain a uniform representative sample. Samples were properly labeled with the aluminum tag and stored in polythene bags for analysis .The processed soil samples were analyzed by standard methods for pH and electrical conductivity (1:2 soil water suspensions), organic carbon (Walkley and Black, 1934), available nitrogen (Subbiah and Asija, 1956), available phosphorus (Olsen et al.,1954), available potassium (Jackson, 1973) and available micronutrients (Fe, Mn, Zn and Cu) in soil samples with extracted diethylene triamine penta acetic acid (DTPA) solution (0.005M) DTPA+0.01M $CaCl_2$ +0.1M triethanolamine, pH 7.3 as outlined by Lindsay and Norvell (1978).

## RESULT AND DISCUSSION

### Chemical Properties

It was observed that soil pH varied from 5.2 to 9.2 with an average of 7.3 according to classification of soil reaction suggested by Brady (1985), 25 samples were normal (7.2 to 7.3), 47 samples were mildly alkaline (pH 7.4 to 7.8), 70 samples were moderately alkaline (pH 7.9 to 8.2). The minimum value of pH 5.2 was observed in Begmabad and Maximum value of pH 9.2 was observed in Piplashivnagar, Nipanya and Milak. The relatively high pH of soils might be due to the presence of high degree of base saturation. The electrical conductivity of the soil varied from 0.120to 0.989 $dSm^{-1}$.

### Organic matter content

Organic carbon content of the soil in rice-mentha+wheat varied from 3.9 to 6.9 g $Kg^{-1}$ soil.The organic carbon content was low (<0.50%) in 26 %, medium (0.5 to 0.75%) in 74 % soil samples. High temperature and more tillage practice in the soil increases the rate of oxidation of organic matter resulting reduction of organic carbon content. Agarwal et al., (1990) reported that organic carbon content of some soil Rajasthan ranged from 0.142 to 0.40 percent.

### Available Nitrogen Content

Soil fertility exhibits the status of different soils regard to the amount and availability of nutrients essentials for plant growth. The available N content in rice-mentha+wheat varied from 156.96 to 259.32 kg $ha^{-1}$ with an average value of 224.32 kg $ha^{-1}$ (table 1). On the basis of rating suggested by Subbiah and Asija (1956), all samples were low (<250 N kg $ha^{-1}$) IN available nitrogen. A significant positive correlation (r =0.933) was found between organic carbon and available nitrogen. This relationship was found because most of the soil nitrogen is in organic form. Similar results were also reported by Verma *et al*. (1980).

### Available phosphorous content

The available phosphorous content in rice-mentha+wheat varied from 21.79 to 56.53 $P_2$ $O_5$ kg $ha^{-1}$ with a mean value of 37.18 $P_2O_5$ kg $ha^{-1}$. On the basis of the limit suggested by Muhr et al. (1963), 92 % samples were medium (20 to 50 $P_2O_5$ kg $ha^{-1}$) and 10% were high (>50 $P_2$ $O_5$ kg $ha^{-1}$) in available phosphorus. A significant positive correlation (r = 0.683) was observed between organic carbon and available phosphorous. A significant positive correlation (r = 0.684) was observed between organic carbon and available phosphorus. This relationship might be due to the presence of more than 50% of phosphorous in organic form and after decomposition of organic matter as humus is formed which forms complex with Al and Fe and that is

positive cover for P fixation with AL & Fe thus reduce phosphorus fixation (Tisdale *et al.*, 1997).

**Available potassium content**

Status of available potassium in the soil in rice-mentha+wheat ranged from 158.20 to 283.25 $K_2O$ Kg $ha^{-1}$ with an average value of 211.92 $K_2O$ kg $ha^{-1}$. According to limit suggested by Mahr et al.(1963), all samples were medium (125 to 300 $K_2O$ kg $ha^{-1}$) in potassium content. A significant positive correlation (r =0.615) was observed between organic carbon and available potassium. This might be due to creation of favorable soil environment with presence of high organic matter. Similar result was also reported by Paliwal (1996)

**Micronutrients**

**Copper**

The DTPA extractable Cu in the surface soil in rice-mentha+wheat of 21 grame panchayat was found to sufficient and varied from 0.258 to 1.708 mg $kg^{-1}$ soil in surface (0-15cm) with a mean value of 1.095. All the observed values were well above the critical limit of 0.20 mg $kg^{-1}$ as proposed by Lindsay and Norvell (1998).

**Iron**

The DTPA -extractable Fe in the surface soil in rice-mentha+wheat of 17 grame panchayatwas was to be sufficient and varied from 3.214 to 16.852 mg $kg^{-1}$ with a mean value of 7.350 mg $kg^{-1}$ . According to critical limit of 4.5 mg $kg^{-1}$ soil as suggested by Lindsay and Norvell (1978).

**Mn**

The DTPA- extractable Mn in surface soil varied from 1.701 to 8.351 mg $kg^{-1}$ soil of 326 locations under rice-mentha+wheat farming system and is sufficient to high since are well above according to critical limit of 1.0 mg $kg^{-1}$ as proposed by Lindsay and Norvell (1978).

**Zn**

The available Zn in surface (0-15 cm) in rice-mentha+wheat ranged from 0.425 to 1.708 mg $kg^{-1}$ soil. Critical limit 0.6 mg $kg^{-1}$ as proposed by Lindsay and Norvell (1978**)** in all the surface soils with exception of Roopppur, Daniyapurand Sayeednagar, Piplashivnagar and Pagamberpur were sufficient in Available Zn content.

**Table 1:** Salient soil properties (weighted mean) of study area.

| S. N. | Name of village | No of samples collected | pH | EC ($dSm^{-1}$) | OC ($gmkg^{-1}$) | Available N ($kgha^{-1}$) | Available $P_2O_5$ ($kgha^{-1}$) | Available $K_2O$ ($kgha^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| 1 | Babura | 20 | 7.6 | 0.318 | 5.7 | 195.46 | 21.79 | 210.67 |
| 2 | Roop Pur | 15 | 7.9 | 0.660 | 5.3 | 219.96 | 32.85 | 205.50 |
| 3 | Purainiya Jadeed | 20 | 8.0 | 0.582 | 6.6 | 255.90 | 28.16 | 190.39 |
| 4 | Tirha | 15 | 8.5 | 0.365 | 5.4 | 208.88 | 41.83 | 207.30 |
| 5 | Kashipur Maghra | 15 | 7.8 | 0.218 | 6.5 | 250.36 | 45.39 | 226.60 |
| 6 | Nipaniya | 20 | 7.0 | 0.785 | 5.8 | 218.62 | 36.21 | 158.20 |
| 7 | Jadopur | 15 | 7.2 | 0.955 | 6.7 | 245.23 | 29.68 | 178.60 |
| 8 | Niyamatnagar | 15 | 6.6 | 0.155 | 5.7 | 225.00 | 44.16 | 205.30 |
| 9 | Meghanagla | 20 | 6.8 | 0.631 | 6.9 | 235.66 | 46.53 | 283.25 |
| 10 | Ashokpur | 12 | 7.5 | 0.251 | 6.5 | 248.88 | 38.33 | 265.60 |
| 11 | Daniyapur | 10 | 7.3 | 0.811 | 4.9 | 209.44 | 45.16 | 272.80 |
| 12 | Mankara | 15 | 8.2 | 0.456 | 4.8 | 196.88 | 42.28 | 214.72 |
| 13 | Lohapatti Bhagirath | 20 | 8.3 | 0.254 | 3.9 | 156.96 | 41.81 | 212.71 |
| 14 | Lohapatti Bholanath | 10 | 5.9 | 0.531 | 6.8 | 259.32 | 29.69 | 206.52 |
| 15 | Sayeednagar | 15 | 6.7 | 0.765 | 5.4 | 226.53 | 28.23 | 160.15 |
| 16 | Piplashivnagar | 20 | 9.2 | 0.120 | 5.9 | 228.78 | 35.42 | 189.20 |
| 17 | Milak | 12 | 9.0 | 0.989 | 6.8 | 246.56 | 38.43 | 201.32 |
| 18 | Pagamberpur | 15 | 8.4 | 0.553 | 5.6 | 210.52 | 42.81 | 198.05 |
| 19 | Nankar | 10 | 6.1 | 0.456 | 6.7 | 246.48 | 46.21 | 220.20 |
| 20 | Naglaudai | 20 | 5.8 | 0.622 | 5.3 | 216.59 | 38.23 | 252.60 |
| 21 | Begmabad | 12 | 5.2 | 0.287 | 4.5 | 208.72 | 27.70 | 190.72 |
| Range | | | 5.2-9.2 | 0.120-0.989 | 3.9 – 6.9 | 156.96 – 259.32 | 21.79 – 46.53 | 158.20 – 283.25 |
| Mean | | | 7.3 | 0.512 | 5.79 | 224.32 | 37.18 | 211.92 |

**Table 2:** DTPA- extractable micronutrients (Cu, Fe, Mn and Zn) status of soil

| S.N. | Name of village | No of samples collected | Cu mg/kg | Fe mg/kg | Mn mg/kg | Zn mg/kg |
|---|---|---|---|---|---|---|
| 1 | Babura | 20 | 0.845 | 16.852 | 3.485 | 1.481 |
| 2 | Roop Pur | 15 | 0.854 | 11.258 | 4.621 | 0.435 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | Purainiya Jadeed | 20 | 0.258 | 8.296 | 3.426 | 0.810 |
| 4 | Tirha | 15 | 0.881 | 13.652 | 5.514 | 1.708 |
| 5 | Kashipur Maghra | 15 | 0.923 | 6.145 | 4.156 | 0.835 |
| 6 | Nipaniya | 20 | 0.869 | 6.253 | 4.152 | 0.823 |
| 7 | Jadopur | 15 | 0.748 | 8.472 | 5.593 | 0.543 |
| 8 | Niyamatnagar | 15 | 1.028 | 3.214 | 1.916 | 0.781 |
| 9 | Meghanagla | 20 | 1.312 | 4.785 | 2.891 | 0.798 |
| 10 | Ashokpur | 12 | 2.415 | 5.596 | 2.245 | 1.839 |
| 11 | Daniyapur | 10 | 0.793 | 4.985 | 2.561 | 0.575 |
| 12 | Mankara | 15 | 2.041 | 10.581 | 8.351 | 1.685 |
| 13 | Lohapatti Bhagirath | 20 | 0.916 | 5.596 | 2.856 | 1.069 |
| 14 | Lohapatti Bholanath | 10 | 1.178 | 4.543 | 4.561 | 0.878 |
| 15 | Sayeednagar | 15 | 0.620 | 6.391 | 5.186 | 0.595 |
| 16 | Piplashivnagar | 20 | 1.541 | 4.045 | 5.170 | 0.583 |
| 17 | Milak | 12 | 0.623 | 6.379 | 2.267 | 0.861 |
| 18 | Pagamberpur | 15 | 1.216 | 11.273 | 5.061 | 0.425 |
| 19 | Nankar | 10 | 1.368 | 3.738 | 1.701 | 0.768 |
| 20 | Naglaudai | 20 | 0.869 | 7.560 | 2.746 | 0.756 |
| 21 | Begmabad | 12 | 1.708 | 4.746 | 3.216 | 0.665 |
| Range | | | 0.258- 1.708 | 3.214 - 16.852 | 1.701 – 8.351 | 0.425 - 1.708 |
| Mean | | | 1.095 | 7.350 | 3.889 | 0.900 |

## CONCLUSION

The study of soil samples reveals that the soil of Milak Tehsil of rampur District were did not followed a particular pattern with different grame panchayat which may be due to variation in management practices and yield potential. Nutrient status regarding to the available macro and micro nutrient in surface soil indicate that soils are low in available N and medium in available P and K and in general marginal in available Cu, Fe, Mn and Zn. Normal to slightly alkaline in reaction, low to medium in organic carbon content (Kumar et.al. 2013**).**

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# VARIABILITY AND GENETIC PARAMETERS FOR GRAIN YIELD IN CMS BASED RICE HYBRID (*ORYZA SATIVA* L.)

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**Abstract :** The present investigation was carried out during *kharif* 2012 and 2013 at Raipur to study the genetic parameters for quantitative and quality characters in eighty three genotypes in rice (*Oryza sativa* L.). Analysis of variance revealed significant differences for almost all the traits under study. The characters, viz. sterile spikelets panicle$^{-1}$, fertile spikelet panicle$^{-1}$, pollen fertility percent, grain yield plant$^{-1}$, spikelet fertility percent, harvest index and biological yield plant$^{-1}$ exhibited high genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV). Small differences between GCV and PCV were recorded for all the characters studied which indicated less influence of environment on these characters. sterile spikelet panicle$^{-1}$, fertile spikelet panicle$^{-1}$, pollen fertility percent, grain yield plant$^{-1}$, spikelet fertility percentage, harvest index, biological yield plant, number of spikelet panicle$^{-1}$, 1000 grain weight and productive tillers plant exhibited high heritability coupled with high genetic advance as per cent of mean indicating that simple selection could be effective for improving these characters.

**Keywords** : Genetic advance, GCV, Heritability, Hybrid rice, PCV

## INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important cereal crops of the world meeting the dietary requirements of the people living in the tropics and sub-tropics. Quantum jump in yield improvement has achieved in rice with the development of high yielding heterotic hybrids under commercial cultivation. However, being the staple food of the population in India, improving its productivity has become a crucial importance Subbaiah *et al*., 2011). The knowledge on the nature and magnitude of genetic variation governing the inheritance of quantitative characters like yield and its components is essential for effecting genetic improvement. It is important to evaluate the promising rice germplasm along with their hybrids for morphological characters and yield. A paradigm shift in the rice (*Oryza sativa* L.) breeding strategies from quantity centered approach to quality oriented effort was inevitable, since India has not only become self sufficient in food grain production but also is the second largest exporter of quality rice in the world (Sreedhar *et al.*,2005). Improvement in grain quality that does not lower yield is the need of hour at present context in order to benefit all rice grower and consumers. Like grain yield, quality is not easily amenable to selection due to its complex nature. For the development of high yielding varieties with good quality the information on variability and genetic parameters of grain quality attributes and their association with each other including grain yield is necessary to formulate suitable breeding strategies for grain quality improvement. In the present investigation, an attempt has been made to elucidate information on nature and magnitude of genetic variation observed for yield and yield components and kernel quality attributes in certain parents and rice hybrids.

## MATERIAL AND METHOD

The present experiment was conducted at Research Farm, Department of Genetics and Plant Breeding, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh.) in *kharif* 2012 and 2013. Raipur is located at 21°16' N Latitude and 81°36' E longitude at an altitude of 289.60 meters above the mean sea level. The materials comprised of eighty three rice genotypes. The experimental material was planted in a completely randomized block design with two replications in two blocks. Each block consisted of thirty three genotypes randomized and replicated within each block. Twenty one days old seedlings were transplanted at 20 cm apart between rows and 15 cm within the row. All necessary precautions were taken to maintain uniform plant population in each treatment. All the recommended package of practices was followed along with necessary prophylactic plant protection measures to raise a good crop. Five representative plants for each genotype in each replication were randomly selected to record observations on the quantitative characters under study. The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) was calculated by the formula given by Burton (1952). Heritability in broad sense ($h^2$) was calculated by the formula suggested by Hanson *et al.* (1956). From the heritability estimates, the genetic advance (GA) was estimated by the formula given by Johnson *et al.* (1955).

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## RESULT AND DISCUSSION

The analysis of variance indicated the existence of significant differences among all the genotypes for almost all the traits studied (Table 1). The variation between genotypic and phenotypic coefficient of variation was high to moderate for all characters studied except days to 50 % flowering and panicle length indication of the more influence of the environment over these two characters (Table 2). The magnitude of coefficient of variation was categorized as high (> 30%), moderate (25%) and low (< 20%). The high genotypic and phenotypic coefficient of variation was recorded for the characters, sterile spikelet panicle$^{-1}$ (70.18 and 72.38), fertile spikelet panicle$^{-1}$ (53.69 and 54.38), pollen fertility percent (45.87 and 46.54), grain yield plant$^{-1}$ (40.53 and 52.16), spikelet fertility percent (39.39 and 39.92), harvest index (30.51 and 32.58) and biological yield plant$^{-1}$ (29.41 and 31.51). The moderate genotypic and phenotypic coefficient of variation were recorded for the characters *viz.* number of spikelet panicle-1 (27.77 cm and 28.94), 1000 grain weight (25.11 cm and 25.63), number of productive tillers (24.76 and 25.25) and total number of tillers (21.04 and 21.33). The low genotypic and phenotypic coefficient of variation was recorded for the characters *viz.* number of tillers (21.04 and 21.33), plant height (18.87 and 20.05), panicle length (10.10 and 11.61) and days to 50% flowering (7.17 and 7.19). The high magnitude of phenotypic coefficient of variation reveals the high genetic with environmental variability present in the material studied. The phenotypic coefficient of variation was recorded higher than genotypic coefficient of variation and was in accordance with verma *et al.* (2000). The present findings of low magnitude of GCV and PCV for days to 50% flowering are in agreement with the findings of Kaw *et al.* (1999). Similar results for high GCV and PCV in rice were also reported by Shukla *et al*. (2005) and Kumar *et al*. (2006) in grain yield plant; Panwar (2005) in spikelet fertility percent and grain yield plant$^{-1}$; Das *et al*. (2005) in productive tillers plant$^{-1}$ and grain yield plant$^{-1}$; Saleem *et al.* (2005) and Jayashudha and Sharma (2010) in spikelet fertility percent; Amudha *et al.* (2006) in productive tillers plant$^{-1}$ and spikelet sterility percent; and Babu *et al.* (2012) in fertile spikelet panicle$^{-1}$ and sterile spikelet panicle$^{-1}$.

The magnitude of heritability was categorized as high (>90%), moderate (85-90%) and low (<80%). All the characters exhibited high broad sense heritability (table 2). Heritability was recorded the highest for days to 50 % flowering (99.63), plant height (98.22), fertile spikelet panicle$^{-1}$ (97.51), spikelet fertility percent (97.38), total numbers of tiller (97.31), pollen fertility percent (97.17), number of productive tiller (96.17), 1000 grain weight (95.99), sterile spikelet panicle$^{-1}$ (94.00), grain yield (92.42) and number of spikelet panicle$^{-1}$ (92.11) whereas, it was found moderate for harvest index (87.71) biological yield plant$^{-1}$ (87.16) and low for panicle length (75.64). The high estimates of heritability for high heritability observed for grain yield plant$^{-1}$ is in conformity with the findings of Satyanaryana *et al.* (2005). Satyanaryana *et al.* (2005) reported high heritability estimates for spikelet sterility percent and days to 50% flowering; Patra *et al.* (2006) for plant height, panicle length and productive tillers plant; Jayashudha and Sharma (2010) for spikelet fertility percent and days to 50% flowering; Babu *et al.* (2012) for days to 50% flowering, fertile spikelet panicle$^{-1}$, sterile spikelet panicle$^{-1}$.

The genetic advance as per cent of mean was categorized as high (>80%), moderate (50-80%) and low (<50%). The high estimate of genetic advance were exhibited as per cent of mean by the characters for sterile spikelet panicle$^{-1}$ (121.14), fertile spikelet panicle$^{-1}$ (112.11), pollen fertility percent (97.51), spikelet fertility percent (87.09), grain yield plant$^{-1}$ (83.33) and moderate for harvest index (61.66), biological yield plant$^{-1}$ (55.49), spikelet panice$^{-1}$ (52.89), 1000 grain weight (50.07). whereas, it was low genetic advance percent of mean for productive tiller (49.86), total number of tiller (42.34) and plant height (42.01), panicle length (17.90), days to 50% flowering (14.87) (Table 2). The high heritability along with high genetic advance were registered as percent of mean for days to 50% flowering, plant height, fertile spikelet panicle$^{-1}$, spikelet fertility percent, number of total tiller plant$^{-1}$, pollen fertility percent, Productive tillers plant$^{-1}$, 1000 grain weight, sterile spikelet panicle$^{-1}$, grain yield plant$^{-1}$, total spikelet panicle$^{-1}$, harvest index, biological yield plant$^{-1}$, panicle length. Therefore, the improvement of these traits through selection is the most important way to achieve the genetic gain generation after generation. High heritability coupled with high genetic advance indicates the preponderance of additive gene action and such characters could be improved through selection. Similar findings were also supported by Das *et al.* (2005) for high heritability coupled with high genetic advance in grain yield plant$^{-1}$, productive tillers plant, sterile spikelet panicle$^{-1}$ and plant height, Mall *et al*. (2005) for plant height, Saleem *et al.* (2005) for grain yield plant, Satyanarayana *et al.* (2005) for spikelet fertility percent, plant height, panicle length, Manna *et al*. (2006) for grain yield plant$^{-1}$, Patra *et al*. (2006) for plant height, Jayashudha and Sharma (2010) for spikelet fertility percent and plant height; and Babu *et al.* (2012) for fertile spikelet panicle$^{-1}$. In the present investigation, it was found that considerable variability was present in the experimental material under study. Therefore, it is concluded that the characters which showed high genotypic value coupled with high heritability and genetic advance should be considered for direct selection. Here sterile spikelet panicle$^{-1}$, fertile spikelet panicle$^{-1}$, pollen

fertility percent, grain yield plant$^{-1}$, spikelet fertility percentage, harvest index, biological yield plant, number of spikelet panicle$^{-1}$, 1000 grain weight and productive tillers plant among field characters showed high GCV, PCV, heritability and genetic advance. Thus one should select these characters for direct selection.

**Table 1.** ANOVA for different quantitative and quality characters of hybrid rice

| Source of variation | df | Mean sum of squares | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **Replication** | 1 | 2.40** | 139.56** | 5.21** | 2.43** | 58.44** | 129.93 | 621.71 | 182.37 | 24.57 | 3.57 | 500.96* | 52.74* | 6.51 | 4.67 |
| **Treatment** | 82 | 103.96** | 984.38** | 8.87** | 9.52** | 15.5** | 9097.64** | 13513.28** | 7117.68** | 1275.17** | 1459.36** | 1341.6** | 302.96** | 51.78** | 256.57** |
| **Error** | 82 | 0.21 | 9.09 | 0.16 | 0.22 | 2.20 | 363.70 | 172.73 | 211.61 | 16.41 | 20.35 | 92.48 | 11.73 | 1.66 | 16.31 |

***= Significant P > 0.05, **= Significant P > 0.01**

1. Days to 50% Flowering
2. Plant height (cm)
3. No. of Tillers
4. Productive tillers
5. Panicle Length(cm)
6. Spikelets/Panicle
7. Fertile spikelets/Panicle
8. Sterile spikelets/panicle
9. Spikelet Fertility (%)
10. Pollen Fertility (%)
11. Biological Yield (g)
12. Grain Yield (g)
13. 1000 grain weight (g)
14. Harvest index (%)

**Table 2.** Genotypic and phenotypic coefficient of variance (GCV and PCV), Heritability ($h^2$) and genetic advance as percentage of mean (GA as percent of mean) for different characters.

| S. N | Characters | Genotypic coefficient of variation (%) | Phenotypic coefficient of variation (%) | Heritabilty (%) Broad sense | Genetic advance | Genetic advance as % mean |
|---|---|---|---|---|---|---|
| 1 | Days to 50% flowering | 7.17 | 7.19 | 99.63 | 15.07 | 14.87 |
| 2 | Plant height (cm) | 19.87 | 20.05 | 98.22 | 45.67 | 42.01 |
| 3 | Tiller number (No.) | 21.04 | 21.33 | 97.31 | 4.27 | 42.34 |
| 4 | Productive tiller (No.) | 24.76 | 25.25 | 96.17 | 4.40 | 49.86 |
| 5 | Panicle length (cm) | 10.1 | 11.61 | 75.64 | 4.60 | 17.90 |
| 6 | Spikelet per panicle (No.) | 27.77 | 28.94 | 92.11 | 130.86 | 52.89 |
| 7 | Fertile Spikelet per panicle (No.) | 53.69 | 54.38 | 97.51 | 169.16 | 112.11 |
| 8 | Sterile spikelet per panicle (No.) | 70.18 | 72.38 | 94.00 | 116.96 | 121.14 |
| 9 | Spikelet fertility (%) | 39.39 | 39.92 | 97.38 | 50.93 | 87.09 |
| 10 | Pollen fertility (%) | 45.87 | 46.54 | 97.17 | 54.17 | 97.51 |
| 11 | Biological yield (gms) | 29.41 | 31.51 | 87.16 | 48.78 | 55.49 |
| 12 | Grain yield (gms) | 40.53 | 52.16 | 92.42 | 23.91 | 83.33 |
| 13 | 1000 grain weight (gms) | 25.11 | 25.63 | 95.99 | 10.12 | 50.07 |
| 14 | Harvest index (%) | 30.51 | 32.58 | 87.71 | 20.95 | 61.66 |

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# EFFICACY OF CERTAIN FUNGICIDES AND BIOAGENTS AGAINST ANGULAR LEAF SPOT OF COTTON (*GOSSYPIUM HIRSUTUM* L.) UNDER FIELD CONDITIONS

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**Abstract :** An experiment was conducted during *kharif* season of 2011-12 central research plot of SHIATS. To find out the efficacy of certain fungicides and bio-agents against *Xanthomonas campestris pv malvaciarum* of cotton different treatment of Bordeax mixture, Neem cake, *Pseudomonas fluorescens*, Streptomycin, *Bacillus subtilis*, Mancozeb, Carbendazim was used as foliar spray. Result that the foliar spray of Streptomycin @ 0.025% was found most effective in reducing the disease severity (17.03%) at 120 DAS, (18.67%) 150 DAS, (20.59%) at 180 DAS and increased yield (29.10 q/ha) at harvest.

**Keyword :** *Xanthomonas campestris pv. malvaciarum*, Fungicides, Bio-agents

## INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is the "White Gold" or the "King of Fibres" enjoys a predominant position amongest all cash crop in India. (Chattannavar, *et al.* 2010). Cotton is one of the most important crops in several part in the world. The primary necesscities of human beings is food, secondary cloth for cover his body. Cotton is full fills the secondary necessities. For the manufacturing of cloths, silk, wood, synthetic fibre etc. cropped fiber are used, but 70% total production of cloths are produced by fiber of cotton. After destruction of fiber in cotton, the cotton seed are also used for foods of animals. After destruction the oil other part khali are used for the burning process with dry wood. Its levies can also be used for mannuar 1 kg cotton stalks which is complete by cellulose helps for growing 500g. mushroom which is full the protein in the food. The cotton is also known as "white cotton." (Ahlawat and Omprakash, 2003). Angular leaf spot or black arm of cotton is the most serious bacterial disease of this crop. The disease was first reported from Alabama State of USA in 1891. In India the disease was first observed in Tamil Nadu in 1918. Several epidemics of the disease were reported during 1948-1952 in Tamil Nadu which resulted in rejection of very promising cotton varieties of all the four species of *Gossypium*. (Singh, 2005). The spread of disease depends much upon climatic condition. In rainy weather, the leaves and stems are attacked, especially when the rains are heavy and accompanied by strong winds. The pathogen is carried by wind-driven rain on to the plants. The most important factors favourable to the pathogen are high relative humidity and high air temperature. (Pandey, 2011). Biological agents has promising results in cotton chemical prove to be more effective but with the growing awareness of chemicals, integrated use of bioagent and chemical seens to be the best method of management. "Efficacy of certain fungicides and bio-agents against angular leaf spot of cotton (*Gossypium hirsutum* L.) under field conditions."

## MATERIAL AND METHOD

A field trial was conducted to check the efficacy of foliar spray with fungicides and bio-agents on Angular leaf spot of cotton at the research plot of the Department of Plant Protection, Sam Higginbottom Institute of Agriculture, Technology & Sciences (deemed to be university) Allahabad. The selected field area was well prepared and plot marked as per the lay out plan. The field was dug up, weeds cleaned and the soil was pulverized and the total area was divided into 24 plots. The experiment was analysed by using RBD (randomized block design) with three replication in a plot size $3x2m^2$. $T_1$- Bordeax mixture @, $T_2$- Neem cake @, $T_3$-*Pseudomonas fluorescens* @, $T_4$- Streptomycin @, $T_5$- *Bacillus subtilis* @, $T_6$- Mancozeb @, $T_7$- Carbendazim @ and the untreated control was used as foliar spray. Observation recorded were disease intensity on leaf at 90, 120, 150, 180 DAS and yield (q/ha).

**Disease intensity (%) was calculated by using the following formula**

$$\text{Disease intensity (\%)} = \frac{\text{Sum of all individual rating}}{\text{Total no. of rating x maximum disease grade}} \times 100$$

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## RESULT AND DISCUSSION

In the present study, the result of experiment conducted to evaluate the "Efficacy of certain fungicides and bio-agents against angular leaf spot of cotton (*Gossypium hirsutum* L.) under field conditions. Under the appropriate heading carried out in *kharif* season 2011-2012 to assess the plant height, number of branches, number ofleaf, disease intensity and cost benefit ratio of crop under field condition. The table comprising of data recorded during the experimental period and suitable figures illustrates the noted variation.

**Table 1.** Effect of different fungicides and bio-agents against angular leaf spot of Cotton (*Gossypium hirsutum* L.) on disease intensity (%) at different intervals

| Treatment No. | Fungicides and bioagents | Concentration | Disease intensity (%) | | | |
|---|---|---|---|---|---|---|
| | | | Before spray | After I spray | After II spray | After III spray |
| | | | 90 DAS | 120 DAS | 150 DAS | 180 DAS |
| $T_1$ | Bordeaux mixture | 0.25% | 14.37 | 17.77 | 20.29 | 23.26 |
| $T_2$ | Neem Cake | 0.50% | 15.55 | 21.03 | 25.48 | 30.67 |
| $T_3$ | *Pseudomonas fluorescens* | 20 g/l. | 14.37 | 17.77 | 20.44 | 23.85 |
| $T_4$ | Streptomycin | 0.025% | 13.77 | 17.03 | 18.67 | 20.59 |
| $T_5$ | *Bacillus subtilis* | 0.01% | 15.40 | 20.14 | 25.18 | 29.18 |
| $T_6$ | Mancozeb | 0.20% | 15.25 | 20.14 | 24.59 | 28.74 |
| $T_7$ | Carbendazim | 0.20 to 0.30% | 14.74 | 19.40 | 23.40 | 26.96 |
| $T_0$ | Control (untreated) | - | 16.59 | 21.47 | 28.44 | 38.74 |
| | | F-test | NS | S | S | S |
| | | S. Ed. (±) | - | 0.34 | 0.13 | 0.27 |
| | | C. D. (P = 0.05) | - | 0.73 | 0.29 | 0.58 |

**Disease intensity (%) at 120 DAS**

The minimum disease intensity (%) was recorded at 60 DAS $T_4$- Streptomycin @ 0.025% (17.03) followed by $T_1$- Bordeaux mixture @ 0.25% (17.77), $T_3$- *Pseudomonas fluorescens* @ 20g/l (17.77), $T_7$- Carbendazim @ 0.20 to 0.30% (19.40), $T_6$- Mancozeb @ 0.20% (20.14), $T_5$- *Bacillus subtilis* @ 0.01% (20.14), $T_2$- Neem cake @ 0.50% (21.03) over $T_0$- control (21.47).

All the treatment were significant over the control but ($T_0$, $T_2$), ($T_5$, $T_6$) and ($T_3$, $T_1$) were non significant with each other.

**Disease intensity (%) at 150 DAS**

The minimum disease intensity (%) was recorded at 90 DAS $T_4$- Streptomycin @ 0.025% (18.67) followed by $T_1$- Bordeaux mixture @ 0.25% (20.29), $T_3$- *Pseudomonas fluorescens* @ 20g/l (20.44), $T_7$- Carbendazim @ 0.20 to 0.30% (23.40), $T_6$- Mancozeb @ 0.20% (24.59), $T_5$- *Bacillus subtilis* @ 0.01% (25.18), $T_2$- Neem cake 0.50% (25.48) over $T_0$- control (28.44).

All the treatment were significant over the control but ($T_3$, $T_1$) were non significant with each other.

**Disease intensity (%) at 180 DAS**

The minimum disease intensity (%) was recorded at 90 DAS $T_4$- Streptomycin @ 0.025% (20.59) followed by $T_1$- Bordeaux mixture @ 0.25% (23.26), $T_3$- *Pseudomonas fluorescens* @ 20g/l (23.85), $T_7$- Carbendazim @ 0.20 to 0.030% (26.96), $T_6$- Mancozeb @ 0.20% (28.74), $T_5$- *Bacillus subtilis* @ 0.01% (29.18), $T_2$- Neem cake @ 0.50% (30.67) over $T_0$- control (38.74).

All the treatment were significant over the control but ($T_5$, $T_6$) were non significant with each other.

In the present study the chemicals tested gave better results for minimizing the PDI. A significant variation of PDI was found among the treatments. All fungicides performed significantly better over the control. Lowest PDI was recorded in streptomycin treated plots. It was statistically similar to Bordeaux mixture, *Pseudomonas flurescens* is also reported by (Naik and Hiremath, 2003) to be effective in controlling the angular leaf spot of cotton. Against *Xanthomonas campestris pv. malvacearum* have reported that streptomycin 0.025 % were significantly superior over control and rest of the fungicides in managing angular leaf spot of cotton have reported that efficacy of *Pseudomonas*

*flurescens* against angular leaf spot of cotton. The reported that it against better results than check in controlling the diseases. The probable reason for such finding may be that these fungicides and bio-agent had inhibitory effect on the *Xanthomonas* growth of the bacteria and may have reduced the inoculum density due to which spread and increase in the disease intensity may have been checked.

**Table 2.** Effect of different fungicides and bio-agents against angular leaf spot of Cotton (*Gossypium hirsutum* L.) on yield (q $ha^{-1}$)

| Treatment No. | Fungicides and bioagents | Concentration | Yield (q $ha^{-1}$) |
|---|---|---|---|
| $T_1$ | Bordeaux mixture | 0.25% | 26.74 |
| $T_2$ | Neem Cake | 0.50% | 23.04 |
| $T_3$ | *Pseudomonas fluorescens* | 20 g/l. | 25.69 |
| $T_4$ | Streptomycin | 0.025% | 29.10 |
| $T_5$ | *Bacillus subtilis* | 0.01% | 23.26 |
| $T_6$ | Mancozeb | 0.20% | 24.44 |
| $T_7$ | Carbendazim | 0.20 to 0.30% | 24.93 |
| $T_0$ | Control (untreated) | - | 15.28 |
| | | F-test | S |
| | | S. Ed. (±) | 0.22 |
| | | C. D. (P = 0.05) | 0.47 |

The maximum yield (q/ha.) was recorded in foliar spray the decreasing order of yield (q/ha) between different treatments is an followes. $T_4$- Streptomycin @ 0.025% (29.10) followed by $T_1$- Bordeaux mixture @ 0.25% (26.74), $T_3$- *Pseudomonas fluorescens* @ 20g/l (25.69), $T_7$- Carbendazim @ 0.20 to 0.30% (24.93), $T_6$- Mancozeb @ 0.20% (24.44), $T_5$- *Bacillus subtilis* @ 0.01% (23.26), $T_2$- Neem cake @ 0.50% (23.04) and $T_0$- control (15.28). Are statistically significant over control. All the treatment were significant over the control.

The seed cotton yields among the treatments were significant. The highest grain yield was recorded in $T_4$ streptomycin 0.025% (29.10 q/ha), followed by $T_1$ (26.74 q/ha), $T_3$ (25.69 q/ha), $T_7$ (24.93 q/ha), $T_6$ (24.44 q/ha), $T_5$ (23.26 q/ha) as compared to control $T_0$ (15.28 q/h).

## CONCLUSION

Based on the result it was from that streptomycin as foliar spray was most effective effective against angular leaf spot of cotton. Three spray of streptomycin @ 0.025% were found effective in reducing the disease intencity and increasing the yield. Streptomycin is an important antibiotic for the management of bacterial disease.

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**SHORT COMMUNICATION**

# GROWTH AND ENERGETICS OF RICE AS INFLUENCED BY PLANTING GEOMETRIES AND SEEDLING DENSITIES UNDER SRI BASED CULTIVATION PRACTICES

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**Abstracts :** All over the world, the importance of agriculture, especially rice production, is increasing. To cope with the rising population, rice production needs to increase following vertical, instead of horizontal, expansion. Varieties have a great effect on the growth performance and yield contributing characters. India is second largest producer after china and has an area of over 42.2 million hectares and production of 104.32 million tonnes with productivity of 2372 kg $ha^{-1}$(Anonymous, 2012). The productivity of rice in Chhattisgarh is 1.80 t $ha^{-1}$ and its area is 3.65 million ha (Anonymous, 2013). Country has also emerged as a major rice consumer. Rice is consumed both in urban and rural areas and its consumption is growing due to high-income elasticity of demand. To meet the growing demand, a rapid increase in paddy production is needed. But, there is little scope to increase the area; hence increase in production and productivity with an improvement in efficiency of production act as a technological breakthrough to meet the growing demand. New approaches in international trade for aromatic rice's have to be developed. The national governments are required to design policies for grain qualities of aromatic rice's for both domestic and international trade.

**Keywords :** Growth, Cultivation, Rice

## INTRODUCTION

The crop plant growing depends largely on temperature, solar radiation, moisture and soil fertility for their growth and nutritional requirements. An unsuitable population crop may have limitation in the maximum availability of these factors. It is, therefore necessary to determine the optimum density of plant population per unit area for obtaining maximum yield. There have been extensive studies on the relationship between yield and plant density. The optimum seedlings per hill ensure the plants to grow in their both aerial and underground parts through efficient utilization of solar radiation, water and nutrients (Miah *et al.*, 2004). When the planting densities exceed the optimum level, competition among plants becomes severe and consequently the plant growth slows and the grain yield decreases. As the tiller production in scented rice is very low and most of them are low yielding. So, it is essential to determine suitable spacing and number of seedlings for scented rice varieties to maximize their yield.

## MATERIAL AND METHOD

The experiment was carried out at Research Cum Instructional Farm, I.G.K.V., Raipur (C.G.) during *kharif* 2012. The soil of experiment field was '*Inceptisols*' (sandy loam) which is locally known as '*Matasi*'. The soil was neutral in reaction and medium in fertility having low N, medium P, high K Climate of this region is sub- humid with an average annual rainfall of about 1200-1400 mm and the crop received 1315.9 mm of the total rainfall during its crop growth. The weekly average maximum and minimum temperature varied in between $25.8^0$C – $31.9^0$C and $12.75^0$C – $25.8^0$C, respectively. The experiment consisting of scented rice variety *Dubraj* with five levels of spacing *viz.* 25 cm x 25 cm, 25 cm x 20 cm, 25 cm x 15 cm, 20 cm x 20 cm and 25 cm x 10 cm and four levels of number of seedlings $hill^{-1}$ *viz.* 1 seedlings $hill^{-1}$, 2-3 seedlings $hill^{-1}$, 4-5 seedlings $hill^{-1}$ and 2 seedlings $hill^{-1}$. The experiment was laid out in randomized block design (RBD) with three replication and fourteen treatments. The treatment *viz.* 25 cm x 25 cm + $S_1$ ($T_1$), 25 cm x 25 cm + $S_{2-3}$ ($T_2$), 25 cm x 25 cm +$S_{4-5}$ ($T_3$), 25 cm x 20 cm + $S_1$ ($T_4$), 25 cm x 20 cm + $S_{2-3}$ ($T_5$), 25 cm x 20 cm + $S_{4-5}$ ($T_6$), 25 cm x 15 cm + $S_1$ ($T_7$), 25 cm x15 cm + $S_{2-3}$($T_8$), 25 cm x 15 cm + $S_{4-5}$ ($T_9$), 25 cm x 10 cm + $S_1$ ($T_{10}$), 25 cm x 10 cm + $S_{2-3}$ ($T_{11}$), 25 cm x 10 cm + $S_{4-5}$ ($T_{12}$), 20 cm x 20 cm + $S_2$ ($T_{13}$), 20 cm x 10 cm + $S_{2-3}$ ($T_{14}$). Transplanting of one, two-three and three-four seedlings $hill^{-1}$, using seed rate of 10 kg $ha^{-1}$, 20 kg $ha^{-1}$, 35 kg $ha^{-1}$ and 40 kg $ha^{-1}$ at the spacing of 25 cm x 25 cm, 25 cm x 20 cm, 25 cm x 15 cm, 25 cm x10 cm, 20 cm x 20 cm, 20 cm x 10 cm respectively. The 12 days old seedlings were transplanted from $T_1$ to $T_{13}$ while 23 days old seedlings were transplanted in the treatment $T_{14}$. Energy inputs were calculated and estimated in Mega Joule (MJ) $ha^{-1}$ with reference to the standard values prescribed by Mittal *et al*. (1985). These inputs were taken to each treatment of rice crops. Energy values, which were taken for energy estimation (Appendix II, III and IV). The standard energy coefficient for seed and straw of rice was multiplied with their respective yields and summed up to obtain the total energy output. The energy input for rice was calculated by adding the respective values under rice

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crops. Energy use efficiency, energy output–input ratio, was calculated as per the following formula:

$$\text{Grain production efficiency (q MJ}^{-1}\text{ x 10}^{-3}\text{)} = \frac{\text{Total produce (q)}}{\text{Energy input (MJ x 10}^{-3}\text{)}}$$

$$\text{Energy output input ratio} = \frac{\text{Energy input}}{\text{Energy output}}$$

Productivity rating index (PRI) was calculated by the actual yield data was used for calculating PRI. It was calculated by using the following formula:

$$\text{PRI} = \frac{\text{Yield obtained from experimental plot (q ha}^{-1}\text{)}}{\text{Standard yield (q ha}^{-1}\text{)}}$$

For scented rice, Standard yield was taken 33.13 q $ha^{-1}$ as reported by Bhandarkar and Sharma (2013).

Production efficiency Production efficiency of scented rice was calculated by using formula given by Tomar and Tiwari (1990) as follows:

$$\text{PE (kg ha}^{-1}\text{ day}^{-1}\text{)} = \frac{\text{Seed yield (kg ha}^{-1}\text{)}}{\text{Duration of crop (days)}}$$

## RESULT AND DISCUSSION

### Effects on energetic of scented rice

The energy input and output, energy input: output ratio and grain production efficiency are presented in Table 1.1, indicating great variation in these parameters. However the maximum grain energy output was observed in the treatment 25 cm x 25 cm + $S_{2\text{-}3}$ ($T_2$) followed by the treatment 25 cm x 25 cm + $S_1$ ($T_1$) it was mainly due to increased grain and straw yield. Similar result was found in case of straw. In case of lowest energy output, it was observed under the treatment 20 cm x 10 cm + $S_{2\text{-}3}$ ($T_{14}$). Whereas, the net gain energy was found maximum under the treatment 25 cm x 25 cm + $S_{2\text{-}3}$ ($T_2$) followed by the treatment 25 cm x 25 cm + $S_1$ ($T_1$) whereas the lowest found in the treatment 20 cm x 10 cm + $S_{2\text{-}3}$ ($T_{14}$). The highest grain production efficiency was obtained under the treatment with 25 cm x 25 cm + $S_{2\text{-}3}$ ($T_2$) and lowest was found under the treatment 20 cm x 10 cm + $S_{2\text{-}3}$ ($T_{14}$). The data reveal that the maximum energy input was observed under the treatment 20 cm x 10 cm + $S_{2\text{-}3}$ ($T_{14}$), followed by the treatments 25 cm x 25 cm +$S_{4\text{-}5}$ ($T_3$), 25x10cm$^2$+$S_1$ ($T_{10}$ ) and 25x10cm$^2$+$S_3$ ($T_{12}$). However the lowest energy input was obtained under the treatments 25 cm x 25 cm + $S_1$ ($T_1$), 25 cm x 20 cm + $S_1$ ($T_4$), 25 cm x 15 cm + $S_1$ ($T_7$) and 25 cm x 10 cm + $S_1$ ($T_{10}$ ). Similar findings were found by Mittal *et al.* (1958).

### Production efficiency and productivity rating index

The production efficiency and productivity rating index are presented in Fig 1.1, indicating production efficiency (PE) and productivity rating index (PRI) influenced significantly due to different treatments and the values were recorded higher under the treatment 25 cm x 25 cm + $S_{2\text{-}3}$ ($T_2$), which was found to be at par with 25 cm x 25 cm + $S_1$ ($T_1$), 25 cm x 20 cm + $S_1$ ($T_4$), 25 cm x 20 cm + $S_{2\text{-}3}$ ($T_5$), 25cm x 15cm + $S_1$ ($T_7$) and 20 cm x 20 cm + $S_2$ ($T_{13}$), In case of productivity rating index, treatments 25 cm x 25 cm + $S_1$ ($T_1$), 25 cm x 25 cm + $S_{4\text{-}5}$ ($T_3$), 25 cm x 20 cm + $S_1$ ($T_4$), 25 cm x 20 cm + $S_{2\text{-}3}$ ($T_5$), 25 cm x 15 cm + $S_1$ ($T_7$) and 20 cm x 20 cm + $S_2$ (2S) ($T_{13}$) found to be at par with the same treatment 25 cm x 25 cm + $S_{2\text{-}3}$ ($T_2$). The lowest PE and PRI were recorded under the treatment 20 cm x 10 cm + $S_{4\text{-}5}$ ($T_{14}$) *i.e.* farmers practice.

### Effect on grain yield and straw yield

The grain, straw yield were significantly influenced due to different treatments. The data are presented in Table 1.1. The treatment 25 cm x 25 cm + $S_{2\text{-}3}$ ($T_2$) produced significantly highest grain yield, which was statistically similar with the treatments 25 cm x 25 cm + $S_1$ ($T_1$), 25 cm x 20 cm + $S_1$ ($T_4$), 25 cm x 20 cm + $S_{2\text{-}3}$ ($T_5$), 25 cm x 15 cm + $S_1$ ($T_7$) and 20 cm x 20 cm + $S_2$ (2S) ($T_{13}$). The lowest grain yield was obtained under narrow spacing with higher seedling density *i.e.* 20 cm x 10 cm + $S_{2\text{-}3}$ ($T_{14}$) *i.e.* farmers practice. The higher grain yield may be due to the application of organic sources of nutrients with inorganic sources of nutrients resulted to greater availability of essential nutrients to plants similar result were found by Porpavi *et al*. (2006). Transplanting of younger seedlings in optimum density at wider spacing facilitate the root growth leading to higher absorption of water and nutrients and ultimately resulting in higher yield. These results are in accordance with Shrirame *et al.* (2000) and Singh *et al.* (2012).

**Table 1.** Energetic of scented rice as influenced by planting geometry and seedling density under SRI based cultivation practices

| Treatment | Energy input (MJ X $10^{-3}$) | Energy output (MJ X $10^{-3}$) | | Net gain energy (MJ X $10^{-3}$) | Energy output-input ratio (MJ X $10^{-3}$) | | Grain production efficiency (q.MJ X $10^{-3}$) | Grain yield (q $ha^{-1}$) | Straw yield (q $ha^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| | | Grain | Straw | | Grain | Straw | | | |
| $T_1$ :25x25cm$^2$+$S_1$ | 12.43 | 54.26 | 93.80 | 148.06 | 4.36 | 7.54 | 2.97 | 36.91 | 75.04 |
| $T_2$: 25x25cm$^2$+$S_{2\text{-}3}$ | 12.58 | 56.15 | 97.39 | 153.54 | 4.46 | 7.74 | 3.04 | 38.20 | 77.91 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **$T_3$ :25x25cm$^2$+$S_{4-5}$** | 12.80 | 50.49 | 89.96 | 140.46 | 3.94 | 7.03 | 2.68 | 34.35 | 71.97 |
| **$T_4$ :25x20cm$^2$+$S_1$** | 12.43 | 52.89 | 81.95 | 134.84 | 4.25 | 6.59 | 2.89 | 35.98 | 65.56 |
| **$T_5$ :25x20cm$^2$+$S_{2-3}$** | 12.58 | 54.15 | 90.41 | 144.57 | 4.30 | 7.19 | 2.93 | 36.84 | 72.33 |
| **$T_6$: 25x20cm$^2$+$S_{4-5}$** | 12.80 | 48.66 | 81.54 | 130.19 | 3.80 | 6.37 | 2.59 | 33.10 | 65.23 |
| **$T_7$ :25x15cm$^2$+$S_1$** | 12.43 | 53.51 | 83.00 | 136.51 | 4.30 | 6.68 | 2.93 | 36.40 | 66.40 |
| **$T_8$ :25x15cm$^2$+$S_{2-3}$** | 12.58 | 49.80 | 78.70 | 128.50 | 3.96 | 6.26 | 2.69 | 33.88 | 62.96 |
| **$T_9$ :25x15cm$^2$+$S_{4-5}$** | 12.73 | 49.26 | 75.45 | 124.71 | 3.87 | 5.93 | 2.63 | 33.51 | 60.36 |
| **$T_{10}$:25x10cm$^2$+$S_1$** | 12.43 | 50.35 | 81.19 | 131.54 | 4.05 | 6.53 | 2.75 | 34.25 | 64.95 |
| **$T_{11}$:25x10cm$^2$+$S_{2-3}$** | 12.58 | 48.35 | 74.76 | 123.11 | 3.84 | 5.94 | 2.61 | 32.89 | 59.81 |
| **$T_{12}$:25x10cm$^2$+$S_{4-5}$** | 12.80 | 47.89 | 71.78 | 119.67 | 3.74 | 5.61 | 2.54 | 32.58 | 57.42 |
| **$T_{13}$.20x20cm$^2$+$S_2$(2S)** | 12.58 | 52.32 | 80.85 | 133.17 | 4.16 | 6.43 | 2.83 | 35.59 | 64.68 |
| **$T_{14}$: 20x10cm$^2$+$S_{2-3}$** | 12.92 | 45.26 | 70.26 | 115.52 | 3.50 | 5.44 | 2.38 | 30.79 | 56.21 |
| **SEm ±** | | | | | | | | **1.28** | **2.18** |
| **CD-** | | | | | | | | **3.74** | **3.09** |

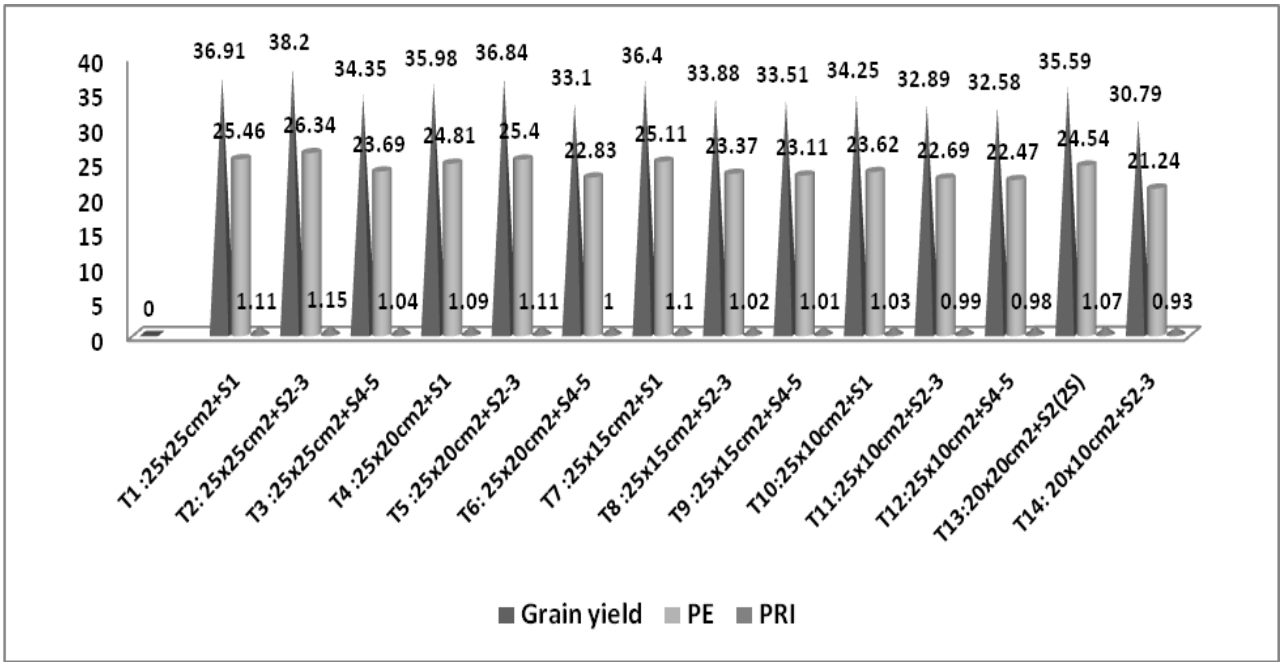


**Fig 1.1.** Grain yield, production efficiency and productivity rating index as of rice as influenced by planting geometries and seedling densities under SRI based cultivation practices

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**SHORT COMMUNICATION**

# PHYTOPLANKTON ASSEMBLAGE IN THE SOLAR SALTPANS OF KANYAKUMARI DISTRICT, TAMIL NADU

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**Abstract :** The quantity and quality of salt production in a solar salt work is determined by the bydrobiological activity (Davis, 1974). Here we report on phytoplankton identified in different saltpans (Kovalam, Thamaraikulam and Puthalam) of Kanyakumari District, India. Totally 45 taxa of phytoplankton were identified in four divisions such as *Bacillariaphyta*, *Chlorophyta*, *Cyanophyt*a and *Dinophyta*. Kovalam saltpan shows high marine cyanobacterial biodiversity than the other two saltpans.

**Keywords**: Phytoplakton, Saltpan, Cyanobacteria

## INTRODUCTION

The microscopic community of plants (Phytoplankton) found usually free floating, swimming with little or no resistance to water currents are called plankton. Phytoplankton usually occurs as unicellular, colonial or filamentous forms and is mostly photosynthetic and is grazed upon by the zooplankton and other organisms, occurring in the same environment. Biological system can help or harm salt production. Benthic and planktonic communities compose the biological system. Benthic communities seal ponds against leakage and also increase the solar energy absorption (Davis, 1993 and Sammy, 1983). This study provides baseline information of the phytoplankton in saltpans for further assessment and monitoring of this type of ecosystems.

## MATERIAL AND METHOD

In Kanyakumari District, currently there are three villages (Kovalam, Thamaraikulam and Puthalam) producing salt. Kovalam, Thamaraikulam and Puthalam are situated near the seashore of Kanyakumari District. Kovalam saltworks use the sea-brine from Arabian Sea for salt production. Thamaraikulam saltworks use backwater for salt production. Puthalam saltworks use sub-soil brackish water for salt production. The availability of phytoplankton was studied for a period of two years (March 2012 to March 2014). Phytoplankton samples were collected through plankton net having a mesh size of 10 µm. The collected samples were kept in plastic bottles and preserved in 5% formaldehyde solution for a short period. In the laboratory all the collected samples were screened with the help of an Olympus light microscope. The taxa were identified using standard manuals (Desikachary, 1959 and Presscott, 1962). Sarma and Khan (1980) identified species, photographs were taken with the help of a digital camera.

## RESULT AND DISCUSSION

In this present investigation, totally 45 genera distributed in 3 different saltpans were recorded (Table – 1). Total of 45 genera belonging to 4 divisions, such as *Bacillariophyta* – 18 genera, *Chlorophyta* – 6 genera, *Cyanophyta* – 16 genera and *Dinophyta* – 5 genera. Among them Kovalam saltpan totally 30 genera were identified. *Bacillariophyta* contributed 10 genera, *Chlorophyta* contributed 3 genera, *Cyanophyta* contributed 15 genera and *Dinophyta* contributed 2 genera. In Thamaraikulam saltpan totally 34 genera were identified. *Bacillariophyta* contributed 15 genera, *Chlorophyta* contributed 5 genera, *Cyanophyta* contributed 11 genera and *Dinophyta* contributed 3 genera. In Puthalam saltpan totally 30 genera were identified. *Bacillariophyta* contributed 11 genera, *Chlorophyta* contributed 6 genera, *Cyanophyta* contributed 9 genera and in *Dinophyta* 4 genera were identified. Primary producers of the studied saltworks ecosystem consist of phytoplankton community. Bacillariophyceae and Cyanophyceae have their maximum growth at pH 7 to 8 (Touliabh *et al*., 2010). Kovalam site shows high marine Cyanobacterial biodiversity than the other two saltpans (Sugumar *et al*., 2011). The same trend of population was noticed in the present study. Diatoms commonly constitute the dominant group of algae in saltpan biofilm of Thamaraikulam saltworks (Wilsy *et al*., 2008). The same trend of population was noticed in the present study. Britten and Johnson (1987) found that the diatoms constituted in the low salinity, but did not occur in salinities above 130 ppt. which is correlated with the results of the present study. Phytoplankton are key organisms in the biological system of saltworks, which must be established and maintained in the ponds in the proper

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condition to allow the economical and continuous production of high quality salt (Ayadi *et al*., 2004). Hence, knowledge above the variability of the ecological factors is necessary to maintain or increase the salt production and improve its quality, proceeding with a careful biomanipulation of the system, when necessary.

**Table 1.** Phytoplankton identified from the Kanyakumari saltpan during the year 2012-2014.

| S.No. | Name of the taxa | Division | Kovalam | Thamaraikulam | Puthalam |
|---|---|---|---|---|---|
| 1 | Achnanthes sp. | Basillariophyta | + | + | – |
| 2 | Amphora sp. | ” | + | + | + |
| 3 | Amphiprora sp. | ” | – | + | + |
| 4 | Biddulphia sp. | ” | + | + | – |
| 5 | Chaetoceras sp. | ” | + | + | – |
| 6 | Cocconeis sp. | ” | – | – | – |
| 7 | Coscinodiscus sp, | ” | + | + | + |
| 8 | Cymbella sp. | ” | – | + | – |
| 9 | Cyclotella sp. | ” | – | – | + |
| 10 | Fragilaria sp. | ” | + | + | – |
| 11 | Frustulia sp. | ” | – | – | + |
| 12 | Navicula sp. | ” | + | + | + |
| 13 | Nitzschia sp. | ” | – | + | + |
| 14 | Pinnularia sp. | ” | – | + | + |
| 15 | Pleurosigma sp. | ” | + | + | + |
| 16 | Surirella sp. | ” | – | + | + |
| 17 | Synedra sp. | ” | + | + | – |
| 18 | Thalasstrosira sp. | ” | + | + | + |
| 19 | Chlorella sp. | Chlorophyta | – | + | + |
| 20 | Closterium sp. | ” | – | – | + |
| 21 | Dunaliella sp. | ” | + | + | + |
| 22 | Pyramimonas sp, | ” | + | + | + |
| 23 | Rhizoclonium sp. | ” | + | + | + |
| 24 | Volvox sp. | ” | – | + | + |
| 25 | Anabaena sp. | Cyanophyta | + | + | + |
| 26 | Anacystis sp. | ” | + | + | – |
| 27 | Aphamocapsa sp. | ” | + | + | + |
| 28 | Aphanotheca sp. | ” | + | – | – |
| 29 | Calothrix sp. | ” | + | – | – |
| 30 | Chroococcus sp. | ” | + | + | + |
| 31 | Gloeocapsa sp. | ” | + | + | + |
| 32 | Gomphosphaeria sp. | ” | – | + | + |
| 33 | Lyngbya sp. | ” | + | + | + |
| 34 | Microcoleus sp. | ” | + | – | – |
| 35 | Microcystis sp. | ” | + | + | – |
| 36 | Myxosarcina sp. | ” | + | – | – |
| 37 | Oscillatoria sp. | ” | + | + | + |
| 38 | Phormidium sp. | ” | + | – | – |
| 39 | Spirulina sp, | ” | + | + | + |
| 40 | Synchococcus sp. | ” | + | + | + |
| 41 | Amphidinium sp. | Dinophyta | + | + | – |
| 42 | Gyrodinium sp. | ” | – | – | + |
| 43 | Hemidinium sp. | ” | – | – | + |
| 44 | Peridinium sp. | ” | – | + | + |
| 45 | Prorocentrum sp. | ” | + | + | + |

‘+’ Present ‘–’ Absent

## CONCLUSION

As a result of this study it was found that majority of 15 sps. of *Cyanobacteria* are present in Kovalam saltpan, 15 sps. of *Bacillariophyta* members were present in the Thamaraikulam saltpan and majority of 6 sps. of *Chlorophyta* members were present in the Puthalam saltpan.

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**SHORT COMMUNICATION**

# AWARENESS OF FARMERS ABOUT CLIMATE CHANGE IN PLAIN ZONE OF CHHATTISGARH

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**Abstract :** In order to combat from adverse effect of climate change and any coping or adaptation strategies, first of all the communities facing climate change should perceive that the changes are indeed taking place. In other words we can say that awareness of farmers regarding changes or variability in climatic condition is important to know its impact on agriculture. To know the level of awareness of farmers regarding climate change, present study was conducted with 240 selected farmers of Plain Zone of Chhattisgarh during the year 2013-14. Most of the farming communities cannot classify the term climate change but are well capable of describing changes in weather. It can be observe from Table 1 that majority of the farmers (70.00%) were fully aware about rise in the risk of crop failure due to climate change has increased, whereas, 65, 54.58 and 52.50 per cent of the farmers were fully aware about pollution is increasing in the atmosphere, climate is getting warmer and weather has become unpredictable, respectively. With regards to overall awareness of about phenomena due to climate change, about 55 per cent of the farmers were moderately aware, whereas, 32.08 and 9.58 per cent farmers belonged to highly aware and somewhat awareness category. Awareness and understanding of farmers on climate change is pre requisite to take appropriate initiatives to combat climate change. The only solution for these huge populations seems to be adequate and relevant adaptation strategies. It has been reported that there is a large deficit of information and knowledge in this vulnerable region which impedes decision making and assessment of climate related risks, and adaptation.

**Keywords :** Farmers, Climate, Crop

## INTRODUCTION

In order to understand how human beings would respond to climate change, it is essential to study people's perceptions of climate and the environment in general (Vedwan et al., 2001). Human expectations regarding weather and climate sometimes lead to perceptions of climate change which are not supported by observational evidences (Rebetcz, 1998). A better understanding of how farmers' perceive climate change, ongoing adaptation measures, and the factors influencing the decision to adapt farming practices is needed to craft policies and programmes aimed at promoting successful adaptation of the agricultural sector (Bryan *et al*., 2009).

As the understanding on global climate and its change is pre requisite to take appropriate initiatives to combat climate change. The only solution for these huge populations seems to be adequate and relevant adaptation strategies. It has been reported that there is a large deficit of information and knowledge in this vulnerable region which impedes decision making and assessment of climate related risks, and adaptation (McSWEENEY *et al.,* 2010). Adaptation to climate change requires that farmers first notice that the climate has altered. Farmers then need to identify potentially useful adaptations and implement them.

Recent studies in climate change in Chhattisgarh indicated that the rainfall pattern has changed during $20^{th}$ century, fluctuations in the onset and offset of monsoon rainfall, decreasing pattern of rainfall in many districts and also the deficit rainfall years increased during the global worming period. Climate is getting hotter in the state due to increasing trend for both maximum and minimum temperature, which, has been showed by many of the studies. With this climatic variability, farmers in the state are vulnerable because their livelihood is totally dependent on agriculture.

## METHODOLOGY

The present study was conducted in 4 selected districts of Plain Zone of Chhattisgarh state. A total of 240 respondents were selected from 24 villages of 8 blocks. Selections were done by using simple random sampling method. The primary data were collected through personal interview with the help of pre-tested structured interview schedule. Collected data were tabulated and processed by using appropriate statistical tools and presented in terms of frequency and percentage.

To determine level of awareness of respondents regarding climate change 12 statements were considered and responses were recorded in three point continuum scale as scores was given 0, 1, & 2 for No, Partial and Complete awareness of respondents, respectively. Further, respondents were categorized into three categories according to scores obtained by them out of total score 24 as follows:

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| Categories | Score |
|---|---|
| Not aware (Score 0) | 0 |
| Somewhat aware (Score up to 8) | 1 |
| Moderately aware (Score between 9-16) | 2 |
| Highly aware (More than 17) | 3 |

## RESULT AND DISCUSSION

Climate change with expected long-term changes in rainfall patterns and shifting temperature zones are expected to have significant negative effects on agriculture, food security and livelihood of the farmers. Most of the farming communities cannot classify the term climate change but are well capable of describing changes in weather. It can be observe from Table 1 that majority of the farmers (70.00%) were fully aware about rise in the risk of crop failure due to climate change has increased, whereas, 65, 54.58 and 52.50 per cent of the farmers were fully aware about pollution is increasing in the atmosphere, climate is getting warmer and weather has become unpredictable, respectively. Most of the respondents were not aware at all about rise in sea level (80.00%), incidences of cyclones are increasing (64.17%) and glaciers are melting (60.42%). While, somewhat awareness belonged to about 52.92, 52.08, 49.17 and 48.75 per cent of the farmers for the phenomena viz. animal health problem are increasing, human health problem are increasing, duration of season is changing and occurrence of extreme weather condition, respectively.

With regards to overall awareness of about phenomena due to climate change, about 55 per cent of the farmers were moderately aware, whereas, 32.08 and 9.58 per cent farmers belonged to highly aware and somewhat awareness category. Very few farmers (3.33%) were not aware about phenomena due to climate change. Similar findings were also reported by Sharma (2010), Aggarwal (2009), Dietz *et al.* (2007) and Kotei *et al.* (2007).

**Table 1.** Distribution of respondents according to their awareness about phenomena due to climatic variability

| Particulars | Level of awareness | | | | | |
|---|---|---|---|---|---|---|
| | Fully aware | | Somewhat aware | | Not aware at all | |
| | F | P | F | P | F | P |
| Climate is getting warmer | 131 | 54.58 | 97 | 40.42 | 12 | 5.00 |
| Weather has become unpredictable | 126 | 52.50 | 101 | 42.08 | 13 | 5.42 |
| Duration of seasons is changing | 64 | 26.67 | 118 | 49.17 | 58 | 24.17 |
| Occurrence of extreme weather conditions | 103 | 42.92 | 117 | 48.75 | 20 | 8.33 |
| Rise in the risk of crop failure has increased | 168 | 70.00 | 62 | 25.83 | 10 | 4.17 |
| Pollution is increasing in the atmosphere | 156 | 65.00 | 72 | 30.00 | 12 | 5.00 |
| Glaciers are melting | 21 | 8.75 | 74 | 30.83 | 145 | 60.42 |
| Incidences of cyclones are increasing | 25 | 10.42 | 61 | 25.42 | 154 | 64.17 |
| Rise in sea-level | 17 | 7.08 | 31 | 12.92 | 192 | 80.00 |
| Occurrence of natural disasters/calamities are increasing | 133 | 55.42 | 100 | 41.67 | 7 | 2.92 |
| Human health problems are increasing | 98 | 40.83 | 125 | 52.08 | 17 | 7.08 |
| Animal health problems are increasing | 94 | 39.17 | 127 | 52.92 | 19 | 7.92 |

**Table 2.** Distribution of respondents according to their level of awareness

| Level of awareness | Respondents (n=240) | |
|---|---|---|
| | F | P |
| Not aware | 8 | 3.33 |
| Somewhat aware | 23 | 9.58 |
| Moderately aware | 132 | 55.00 |
| Highly aware | 77 | 32.08 |

## CONCLUSION

Today we are facing lots of challenges in acquiring knowledge and awareness about climate change and its impact on agriculture, that's why there is a gap between what we are capable of doing and what is actually being done. Which is need for better adaptation in the present scenario of climate change? The study showed mixed type of responses of farmers about awareness of climate change. Some people were fully aware of climate change but majority of them lacked in firsthand knowledge about climate change. So, to solve the problem of climate change at first we have to create awareness among the farmers by using mass media followed by individual contact method through trained extension agents. Such understanding of the farmers may provided an opportunity to take proper action towards better adaptation against bad consequences of climate change.

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**SHORT COMMUNICATION**

# GENETIC ANALYSIS OF YIELD AND ITS CONTRIBUTING TRAITS IN BRINJAL (*SOLANUM MELONGENA* L.)

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**Abstract:** The estimated value of additive genetic component $(\hat{D})$ was significant for all characters- days to flowering, height of plant, number of branches per plant, length of leaf, width of leaf, length of fruit, width of fruit, number of fruit per plant, width of fruit, number of fruit per plant, weight of fruit and fruit yield per plant. The value of $(\hat{H}_1)$ was observed higher than the $(\hat{H}_2)$ and additive genetic component $(\hat{D})$ for all the traits. The estimates of dominant component $(\hat{H}_2)$ was also higher than additive genetic component $(\hat{D})$ for all the traits except width of fruit. The estimated value of $(\hat{h}^2)$ was found positive and significant all the characters except four characters plant height, number of branches per plant, length of fruit and fruit yield per plant. The estimated value of $(\hat{F})$ was found to be positive and significant for all the characters except for days to flowering number of branch per plant, length of leaf, length of fruit, and width of fruit. The estimated value of $(\hat{E})$ was found to be non significant for all the characters except of dominance $(\hat{H}_1/\hat{D})^{0.5}$ reflected over dominance for all the characters. The computed ratio of $\hat{h}_2/\hat{H}_2$ being less than unity for all characters except days to flowering, length of leaf, width of leaf, width of fruit.

**Keywords :** Brinjal, Yield, Genetic analysis

## INTRODUCTION

Brinjal or egg plant (*Solanum melongena* L.) belonging to the family Solanaceae is one of the most important vegetable crop grown in India and other part of world. It is a perennial plant but grown as annual brinjal all over country and main vegetable of plains. Where it is available round the year it is grown throughout year under tropical and sub tropical conditions and usually finds it place in common men's kitchen. Brinjal is native of India, one of the most popular vegetable grown throughout country espcilly in north east region there are wild relative of brinjal and are being grown in their in kitchen garden. The unripe fruit are used as a cooked vegetable. Brinjal has three main botanical varieties under the species *melongena*, the round or egg shaped cultivars group under var. *Esculantum*, the long selnder type are under var. *Serpentinum*, and the dwarf brinjal plant are put under var. *Depressum*. Brinjal has ayurvedic medicinal properties. The fruits of brinjal are excellent remedies for those suffering from lever troubles. White brinjal is good for diabetic patients. Brinjal is good source of vitamin A, B and C. The green leaves of brinjal are excellent source of vitamin C. The bitter source of brinjal is due to glycoalkaloids . In India, annual production of vegetables comprised of 133.73 million tones from the from the 7.98 million hectare during the period of 2009-2010. Brinjal occupies 10.56 million tones of production from the area of 0.61 million hector along with the productivity of 17.2 (metric tones per hectare) in the year 2009-2010. The knowledge of nature and magnitude of gene action controlling the characters under consideration, specific combining ability of the parents and degree of heterosis are helpful in determining the efficient conventional breeding and hybrid breeding procedures. The genetic diversity of the parent influence the performance of hybrids and segregating generations and increase the chance of recovering desirable transgressive segregants and the thus enhancing the effectiveness of selections. The study of heterosis reveals the possibility of commercial exploitation of hybrid vigour. It also helps the breeder in eliminating less productive $F_1$ hybrids and thereby enabling him to concentrates his attention to the few but more productive crosses. The success of the breeding programme depends upon the promising parent from the gene pool, clear understand of component of variation, general and specific combing ability, heritability and genetic advance of the character should be under consideration and will help the breeder in deciding the appropriate breeding method to improve the genetic makeup as well as to make a dent in productivity.

## MATERIAL AND METHOD

The experiment was carried out at Research farm, Department of Vegetable Science, Chandra Shekhar Azad University of Agriculture and Technology, Kalyanpur Kanpur (U.P.) The experimental material for research work comprised of ten varsities

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germplasme Namely Azad B-1, Type-3, KS-224, KS-235, DVR-8, Azad Kranti, KS-331, PPL, KS-503 and KS-504 round and Long showing wide spectrum of variation for different characters. These varieties were crossed in (non reciprocal) diallel fashion to generate a set of forty five crosses. The distinguishing characters are given bellow. Thirty days old healthy and uniform seedlings of different parents and hybrids were transplanted on 20/07/2009 in the afternoon at the distance of 75cm row to row and 60cm plant to plant. Gap filling was done after 5days of transplanting. Observation in respect to 10 plant characters were recorded on 5 randomly selected competitive plant from each plot. The following characters were studied. Days to flowering, Height of plant (cm), Number of branches per plant, Length of leaves (cm),Width of leaves (cm), Length of fruit (cm), Width of fruit (cm), Number of fruit per plant, Weight of per fruit (g), Fruit yield per plant (kg).

## RESULT AND DISCUTION

The estimates of all the genetic components of variance namely $\hat{D},\hat{H}_1,\hat{H}_2,\hat{F},\hat{h}^2$ and $\hat{E}$ along with standard error and related statistics are presented in (table- 4) revealed the fallowing result. The estimates of additive genetic component ($\hat{D}$) was significant for days to flowering, height of plant, number of branches per plant. length of leaf (cm), width of leaf (cm), length of fruit (cm), width of fruit (cm), number of fruit per plant, weight of per fruit (g) and fruit yield per plant (kg). The dominance component ($\hat{H}_1$) was found to be highly significant for all characters-Days to flowering, height of plant, number of branches per plant, length of leaf (cm), width of leaf (cm), length of fruit (cm), width of fruit (cm), number of fruit per plant, weight of per fruit (g), fruit yield per plant (kg). The value of ($\hat{H}_1$) was observed higher than the ($\hat{H}_2$) and additive genetic component ($\hat{D}$) for all the traits. The estimates of dominant component ($\hat{H}_2$) was also higher than additive genetic component ($\hat{D}$) for all the traits except width of fruit (17.58).

The value of ($\hat{F}$) component were positive and significant for all the characters except for days to flowering, number of branches per plant, Length of leaf (cm), Length of fruit (cm), and Weight of per fruit (g). The positive value indicated the frequent involvement of dominant gene for its expression. The value of ($\hat{h}^2$) was observed to be positive and significant for all the characters except height of plant (cm) and number of branches per plants. The estimates of environmental component ($\hat{E}$) was found non significant for all the characters except height of plant (cm), weight of per fruit (g) and fruit yield par plant (kg). The average degree of dominance $\left[\hat{H}_1/\hat{D}^{0.5}\right]$ was more than unity for all the characters showing over dominance. The ratio of positive and negative genes $\left[\hat{H}_2/4\hat{H}_1\right]$ was less than is the theoretical value (0.25) for all the characters which emphasized the asymmetrical distribution of positive and negative alleles among parents. The Proportion of dominance and recessive genes. $\left[4\hat{D}\hat{H}_1^{0.5}+\hat{F}/(4\hat{D}\hat{H}_1)^{0.5}-F\right]$ Was more than unity for all the characters; it means dominant gene were more frequent than

Recessive gene for all characters. The estimated value of $\hat{h}^2/\hat{H}_2$ was observed less than one for all characters except days to flowering, length of leaf (cm), width of leaf (cm), width of fruit (cm), and number of fruit par plant it indicated that at least one major gene group is responsible for inheritance of these characters.

**Table 1.** Estimates of the variance components and related statistics for 10 characters in a 10- parent- diallel-cross of $F_1$ in Brinjal

| Characters | D | $H_1$ | $H_2$ | F | $h_2$ | E | $(H_1/D)^{0.5}$ | $H_2/4H_1$ | KD/KR | $h_2/H_2$ | r | KD/KR | $h_2/H_2$ | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Days to flowering** | 1.38**<br>1.44 | 23.42**<br>3.07 | 22.67**<br>2.61 | -1.00<br>3.33 | 37.88**<br>1.75 | 0.40<br>0.43 | 4.12 | 0.24 | 0.84 | 1.67 | 0.61 | 0.84 | 1.67 | 0.61 |
| **Height of plant(cm)** | 14.14**<br>2.26 | 339.11**<br>55.89 | 175.30**<br>47.50 | 54.79**<br>60.58 | 2.07<br>31.79 | 2.46*<br>7.92 | 4.11 | 0.18 | 2.78 | 0.01 | 0.21 | 2.78 | 0.01 | 0.21 |
| **No. of branches/plant** | 0.30*<br>0.37 | 4.37*<br>0.80 | 3.41*<br>0.68 | 0.94<br>0.86 | 1.26<br>0.45 | 0.28<br>0.11 | 3.83 | 0.20 | 2.39 | 0.37 | 0.25 | 2.39 | 0.37 | 0.25 |
| **Length of leaf(cm)** | 1.87**<br>2.30 | 32.37**<br>4.90 | 30.70*<br>4.16 | 0.93<br>5.31 | 115.67**<br>2.79 | 0.75<br>0.69 | 4.16 | 0.24 | 1.13 | 3.77 | 0.76 | 1.13 | 3.77 | 0.76 |
| **Width of leaf(cm)** | 4.73**<br>1.04 | 24.02**<br>2.22 | 20.98**<br>1.88 | 6.71*<br>2.40 | 114.30**<br>1.26 | 0.28<br>0.31 | 2.25 | 0.22 | 1.92 | 5.45 | 0.96 | 1.92 | 5.45 | 0.96 |
| **Length of fruit(cm)** | 7.56**<br>2.20 | 24.54**<br>4.68 | 23.46**<br>3.98 | -2.93<br>5.07 | 6.12*<br>2.66 | 0.29<br>0.66 | 1.80 | 0.24 | 0.81 | 0.26 | 0.91 | 0.81 | 0.26 | 0.91 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Width of fruit(cm)** | 17.58** 1.79 | 16.32** 3.80 | 13.54** 3.23 | 11.87* 4.12 | 30.39** 2.16 | 0.21 0.54 | 0.96 | 0.21 | 2.08 | 2.25 | 0.72 | 2.08 | 2.25 | 0.72 |
| **No. of fruit/plant** | 7.82** 3.34 | 38.75** 7.11 | 33.56** 6.04 | 10.40* 7.70 | 34.29** 4.04 | 0.35 1.01 | 2.23 | 8.22 | 1.85 | 1.02 | 0.61 | 1.85 | 1.02 | 0.61 |
| **Weight of per fruit(g)** | 1279.44** 545.34 | 4283.43** 1160.80 | 3841.48** 986.56 | -1387.25 1258.26 | 753.47** 660.36 | 91.97** 164.43 | 1.83 | 0.22 | 0.54 | 0.02 | 0.91 | 0.54 | 0.02 | 0.91 |
| **Fruit yield/plant(kg)** | 0.38* 0.28 | 3.97* 0.59 | 2.68* 0.50 | 0.73* 0.64 | 0.69* 0.33 | 0.03* 0.08 | 3.23 | 0.17 | 1.84 | 0.26 | 0.15 | 1.84 | 0.26 | 0.15 |

*Significant at 5 per cent
**Significant at 1 per cent

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**SHORT COMMUNICATION**

# YIELD ATTRIBUTING CHARACTERS AND YIELD OF SAFFLOWER UNDER RICE BASED CROPPING SYSTEM

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**Abstract :** A field experiment was conducted during 2013 at Indira Gandhi Krishi Vishwavidyalaya, Raipur under *Alfisol* soil. Three tillage practices, zero tillage ($T_1$), minimum tillage ($T_2$) and conventional tillage ($T_3$) in main plot along with six irrigation and mulching treatments, no irrigation ($I_1$), no irrigation + mulch ($I_2$), irrigation at critical growth stage (branching + flowering) ($I_3$), irrigation at critical growth stage (branching + flowering) + mulch ($I_4$), two irrigation at 30 days interval ($I_5$) and two irrigation at 30 days interval + mulch ($I_6$) in sub-plot were used. Maximum yield attributing characters and yield was obtained under conventional tillage ($T_3$) as compared to minimum tillage ($T_2$) and zero tillage ($T_1$). The irrigation at critical growth stage (branching + flowering) + mulch ($I_4$) treatment was found to be the best with 1670 kg ha$^{-1}$ and 1756 kg ha$^{-1}$ seed yield and stover yield followed by irrigation at critical growth stage (branching and flowering) ($I_3$) and two irrigation at 30 days interval + mulch (rice straw) ($I_6$). The mulching treatments gave higher yields as compared to non-mulch treatments.

**Keywords:** Economics, Productivity, Yield, Safflower

## INTRODUCTION

Safflower (*Carthamus tinctorius* L.) commonly named as *Kusum* or *Kardi* is a multi-purpose plant grown in India since ancient time for orange red dye extracted from its glittering florets as well as for its seed oil. It is an oilseed highly adapted to arid and semi-arid conditions. Therefore, it constitutes an interesting alternative for diversification and intensification of resources in limiting areas for other oil crops. It grows in rainfed condition and can be established as rabi crop in limited or conserved soil moisture. Movahhedy *et al*. (2009) reported that safflower is generally produced on marginal lands that are relatively dry and relatively deprived of the benefit of fertilizer inputs or irrigation.

## MATERIAL AND METHOD

The present investigation was conducted under irrigated conditions during *kharif* season of 2013 at Indira Gandhi Krishi Vishwavidyalaya, Raipur under rice based cropping system. The treatments included three tillage practices, zero tillage ($T_1$), minimum tillage ($T_2$) and conventional tillage ($T_3$) in main plot and six irrigation + mulch practices, no irrigation ($I_1$), no irrigation + mulch (rice straw) ($I_2$), irrigation at critical growth stage (branching + flowering) ($I_3$), irrigation at critical growth stage (branching + flowering) + mulch (rice straw) ($I_4$), two irrigation at 30 days interval ($I_5$) and two irrigation at 30 days interval + mulch (rice straw) ($I_6$) in sub-plot.

## RESULT AND DISCUSION

Number of heads plant $^{-1}$, head length, head diameter, no. of seeds plant$^{-1}$, seed and stover yield and harvest index of safflower has been presented in Table 1. Significantly maximum values were observed under conventional tillage ($T_3$) followed by minimum tillage ($T_2$) whereas significantly minimum values were recorded with zero tillage ($T_1$). Irrigation at critical growth stage (branching and flowering) + mulch (rice straw) ($I_4$) produced significantly maximum number of number of heads plant $^{-1}$, head length, head diameter, no. of seeds plant$^{-1}$, seed and stover yield followed by irrigation at critical growth stage (branching and flowering) ($I_3$) treatment and two irrigation at 30 days interval + mulch (rice straw) ($I_6$) whereas significantly minimum values were recorded with no irrigation ($I_1$) treatment. The interaction effect of tillage and irrigation + mulching treatments showed maximum yield under $I_4 + T_3$. However, it was found at par with $I_3 + T_3$ and $I_4 + T_2$, $I_4 + T_2$ and $I_6 + T_2$. Significantly minimum seed yield was obtained under $I_1 + T_1$ treatment (Table 2).

Zero tillage leads to lower temperature of topsoil, which further decreases the rate of root growth (Logsdon *et al.*, 1987) and higher soil bulk density under zero tillage and minimum tillage hinders root growth (Logsdon *et al.*, 1987). The plant height and plant population were found higher under conventional tillage ($T_3$) which was found at par with minimum tillage ($T_2$) at 30 DAS, 60 DAS as well as at harvest. Head length, head diameter, number of heads plant$^{-1}$, number of seeds plant$^{-1}$ were also found higher under conventional tillage ($T_3$). Therefore, the seed yield was found higher under conventional

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tillage as it depends on the growth and yield attributes. Hajabbasi and Hemmat (2000) have also reported that the yield production increased with the number and depth of tillage operation. Zaman and Das (1990) have also reported that higher safflower yield was obtained on mulch application which prevents the loss of moisture from the soil and thus improves soil texture.

**Table 1.** Heads plant$^{-1}$, head length, Head diameter number of seeds plant$^{-1}$, seed yield, stover yield and harvest index of safflower under rice-based system as influenced by different treatments.

| Treatment | | Heads plant$^{-1}$ (number) | Head Length (cm) | Head diameter (cm) | Number of seeds plant$^{-1}$ | Seed yield (kg ha$^{-1}$) | Stover yield (kg ha$^{-1}$) | Harvest index |
|---|---|---|---|---|---|---|---|---|
| **Tillage** | | | | | | | | |
| $T_1$ - | Zero tillage | 21.92 | 2.10 | 2.10 | 411.71 | 1268 | 2000 | 38.34 |
| $T_2$ - | Minimum tillage | 22.92 | 2.12 | 2.12 | 446.49 | 1566 | 2246 | 40.98 |
| $T_3$ - | Conventional tillage | 23.72 | 2.15 | 2.15 | 464.70 | 1621 | 2338 | 40.84 |
| **SEM±** | | 0.16 | 0.00 | 0.00 | 0.92 | 5.27 | 21.54 | 0.26 |
| **CD at 5 %** | | 0.43 | NS | NS | 2.54 | 14.64 | 59.80 | 0.72 |
| **Irrigation + Mulch** | | | | | | | | |
| $I_1$ - | No irrigation | 21.50 | 2.11 | 2.11 | 366. 58 | 1120 | 1983 | 35.39 |
| $I_2$ - | No irrigation + mulch (Rice straw) | 21.70 | 2.12 | 2.12 | 373.86 | 1247 | 2012 | 38.41 |
| $I_3$ - | Irrigation at critical growth stage (branching and flowering) | 23.50 | 2.13 | 2.13 | 497.80 | 1682 | 2407 | 41.12 |
| $I_4$ - | Irrigation at critical growth stage (branching and flowering) + mulch (Rice straw) | 24.11 | 2.16 | 2.16 | 505.62 | 1700 | 2471 | 40.74 |
| $I_5$ - | Two irrigation at 30 days interval | 22.99 | 2.10 | 2.10 | 413.52 | 1539 | 2099 | 42.27 |
| $I_6$ - | Two irrigation at 30 days interval + mulch (Rice straw) | 23.30 | 2.11 | 2.11 | 488.42 | 1622 | 2196 | 42.40 |
| **SEM±** | | 0.11 | 0.00 | 0.00 | 0.66 | 11.85 | 8.29 | 0.23 |
| **CD at 5 %** | | 0.25 | NS | NS | 1.47 | 26.40 | 18.47 | 0.52 |

**Table 2.** Interaction effect of different treatments on seed yield of safflower under rice-based cropping system.

| Treatment | | Seed yield (kg ha$^{-1}$) | | | |
|---|---|---|---|---|---|
| | | Tillage | | | |
| **Irrigation + Mulch** | | $T_1$ | $T_2$ | $T_3$ | Mean |
| $I_1$ - | No irrigation | 798 | 1229 | 1333 | 1120 |
| $I_2$ - | No irrigation + mulch (Rice straw) | 978 | 1377 | 1387 | 1247 |
| $I_3$ - | Irrigation at critical growth stage (branching and flowering) | 1535 | 1735 | 1776 | 1682 |
| $I_4$ - | Irrigation at critical growth stage (branching and flowering) + mulch (Rice straw) | 1564 | 1762 | 1773 | 1700 |

| | | | | | |
|---|---|---|---|---|---|
| **$I_5$ -** | Two irrigation at 30 days interval | 1362 | 1544 | 1712 | 1539 |
| **$I_6$ -** | Two irrigation at 30 days interval + mulch (Rice straw) | 1369 | 1750 | 1745 | 1622 |
| **Mean** | | 1268 | 1566 | 1621 | |

| | **Irrigation + Mulch** | **Tillage** | **Interaction (T x I)** |
|---|---|---|---|
| **SEm±** | 11.85 | 5.27 | 13.61 |
| **CD at 5 %** | 26.40 | 14.64 | 31.10 |

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**SHORT COMMUNICATION**

# EFFECT OF CROP GEOMETRY AND WEED MANAGEMENT PRACTICES ON GROWTH AND PRODUCTIVITY OF SOYBEAN

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**Abstract :** A field experiment was conducted during Kharif season at 2007 at Research-cum-Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh), India, .to study the Effect of crop geometry and herbicides on growth and productivity in soybean(Glycine max L. Merrill). The experiment was laid out in Split plot Design (SPD) with two treatments main plot six treatments sub plots and three replication. At harvest, not significant affect by plant spacing but significantly higher seed yield obtained with treatment Fluchoralin@ 100 g $ha^{-1}$ (PE) + Hand weeding at 40 DAS (2354 kg $ha^{-1}$), however, it was found comparable with the yield of Hand weeding twice at 20 and 40 DAS (2316 kg $ha^{-1}$). Significantly lowest weed count and highest weed control efficiency also recorded with T6

**Keywords :** Crop, Effect, Growth, Productivity, Soybean

## INTRODUCTION

The Soybean *(Glycine max* L. Merrill) is recognized as one of the premier agriculture crops. It has revolutionized the agricultural economy with its immense potential for food, fuel and numerous industrial products. It contains 19-20% oil, 40-42% protein, 20-30% carbohydrates, vitamins and other essential amino acids. The root of the soybean those of the most legumes, harbor micro organism that fix nitrogen from the atmosphere enabling the plant to grow within limits on marginal soil that cannot support most other crops. This characteristic has made soybean to fit well in sustainable agriculture. Soybean due to its various uses is rightly called "Golden Gift" of nature to mankind

Weed flush come at the same time almost all the *kharif* crops, which also restrict the availability of manpower for weeding operation in the crop. The ultimately and poor weed management adversely affect proper growth and yield of soybean. It is estimated that the loss in yield of soybean in the tune of 30 to 77 per cent due to poor weed control (Chandel and Saxena, 1998 and Tiwari and Khurchania, 1990). These losses can be alleviated by effective integrated weed management practices. Crop geometry play an important role in contributing the higher yield because dance plant population will not get proper light for photosynthesis and can easily affected by diseases. On other hand poor population reduced the yield. Plant population by manipulating the planting geometry exerts marketed influence on the yield potential the soybean crop. Besides arrangement of plant in a given area is also important consideration in respect to weed population. Alleviating weed competition through weed management practices was found to be effective in enhancing crop yield of soybean. The use of selective herbicides in soybean seems to be effective and economical. However, effectiveness depends upon the weed flora and their time of emergence. The traditional methods of weed control, *viz*, manual and mechanical methods are cumbersome and time consuming and hence prove costly. However, many times non-availability of labourers at critical period leads to ineffective control of weeds and severe crop-weed competition. The crop-weed competition starts from the beginning, since the crop and weed emerge simultaneously, thus, warrants the suitable weed management practices to get effective, timely and economical control of weeds in soybean. Therefore, it is of paramount importance that the weeds are to be kept under check right from the beginning for efficient utilization of applied inputs. To overcome this problem integrated weed management practices need to be adopted as per suitability of given agro-ecological situations. Now a days a few herbicides like Alachlor, Fluchloralin, Fenoxyprop-e-ethyl are available, which can be used safely in soybean. It has been reported that most of the selective herbicides do not control all the weeds present in the crop. Therefore integrated approach of chemical and cultural control may be more feasible and tractable. In view the above facts present investigation was carried out *during Kharif season of year 2007 at Research-cum-Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh), with objective Effect of crop geometry and herbicides on* growth and productivity *in soybean(Glycine max L. Merrill).*

## MATERIAL AND METHOD

The experimental was conducted *during kharif season of year 2007 at Research-cum-Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh),* field was clayey in texture with medium in available nitrogen (216.6 kg $ha^{-1}$) and in available phosphorus (12.14 kg $ha^{-1}$) available potassium (366.2 kg $ha^{-1}$) contents. The experiment

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was laid in split plot design with three replications. Soybean variety "JS-335" was sowing on 6 July at the seed rate of 75 kg seed per ha. and harvested on October 23 I

The experiment was laid out in Split plot Design (SPD) with three replication. The treatments compare two treatment 45*5cm and 30*10cm plant spacing main plot and six treatments sub plots and three replication. $W_{1:}$ Weedy check $W_2$ : Two hand weeding 20 and 40 days after sowing $W_3$ : lachlor 1.50 kg ai $ha^{-1}$ Pre- emergence $W_4$: Alachlor 2.0 kg ai $ha^{-1}$ Pre -mergence $W_5$: Fenoxaprop-p-ethyl 75 g $ha^{-1}$ pre-emergence $W_6$ : Fluchloralin 1.0 kg ai $ha^{-1}$ Pre-emergence + hand weeding at 40 days after sowing by using the Knapsack sprayer fitted with flat fan nozzle with volume of 750 lit/ ha water. Recommended dose of fertilizer 20 kg N, 80 kg P,5 kg Z/ha was applied as basal at the time of sowing. Soybean seed treated with thiram 75% WP 2g + bavistine 1.0 g per kg of seed before inoculation followed by inoculating with *Bradyrhizobium japonicum* culture (7g/kg of seed) To protect the crop from stem fly, 2 to 3 spray of trizophos 40 EC 500 ml/ha was done in the year of experimentation. Thinning was perform to maintain optimum plant population (i.e. 0.4 million plants/ha) during 15-20 DAS.

Weed control efficiency (WCE) was computed by using formula, WCE = (P-Q/P) x 100, where P and Q respectively, refer to oven dry weight of weeds at specific sampling in weedy check and particular treatment for which value is computed. Weed index (WI) was computedby WI = (A-B/A) x 100, where A and B refer to grain yield in weed-free and treated plots respectively

## RESULT AND DISCUSSION

Result revealed that the plant height and dry matter production of soybean plant did not significantly affected by any crop geometry. Fluchloralin @100 g $ha^{-1}$ (PE) + Hand weeding at 40 DAS produce significantly taller and heavier plants than others at 90DAS and at harvest. It was found at par to hand weeding twice at 20 and 40 DAS. The highest plant height and dry matter production was recorded under above treatments are mainly due to lower crop weed competition. Crop growth rate (g $day^{-1}$ $plant^{-1}$) and Relative growth rate (g $g^{-1}$ $day^{-1}$ $plant^{-1}$) did not significantly affected by any crop geometry and all the treatment. In case of different crop geometry, plant height (cm) at harvest, Pods plant $^{-1}$, Seed plant $^{-1}$, 100 seed weight (g) at harvest did not show significant differences in crop geometry. Concerning to weed management practices number of Pods plant $^{-1}$ at harvest recorded significantly maximum under treatment Fluchloralin @100 g $ha^{-1}$ (PE) + Hand weeding at 40 DAS than others .it was found at par to Hand weeding twice at 20 and 40 DAS

Seed yield of soybean did not show significant differences in crop geometry. Significantly higher seed and stover yield of soybean was found under treatment Fluchloralin @100 g $ha^{-1}$ (PE) + Hand weeding at 40 DAS (2354kg $ha^{-1}$) than others. it was found at par to Hand weeding twice at 20 and 40 DAS(2316kg $ha^{-1}$) The yield and yield attributing characters, *viz.* Pods plant $^{-1}$, Seed plant $^{-1}$ and 100 seed weight (g) were significantly influenced by different weed control treatments (Table 2). Among herbicidal applications, significantly higher seed yield obtained with treatment Fluchoralin@ 100 g $ha^{-1}$ (PE) + Hand weeding at 40 DAS.

Weed control efficiency is directly proportional to dry matter production of weed. Maximum weed control efficiency was observed under Fluchloralin @ 1000 g $ha^{-1}$ (PE) + Hand weeding at 40 DAS respectively followed by Hand weeding twice at 20 and 40 DAS. This might be owing to less dry matter production and population of weed in the above treatment. The lower weed population and higher weed control efficiency also resulted in higher grain yield. similar findigs were reported by Chandel and Saxena(2001)and Raman and Krishnamoorthy (2005).contrarily the poor growth of plants as well as development of yield attributes in weedy chek might be due to higher weed interference, less space and nutrient available at the time of flowering and pod development adversely influenced the seed yield.

## CONCLUSION

Closer row spacing recorded most appropriate for maximization of yield attributes, growth and seed yield (985 kg $ha^{-1}$) of soybean.The minimum population and dry matter production of weeds with maximum weed control efficiency (77.34%) and the highest economic returns in terms of gross realization (Rs 32000 $ha^{-1}$), net realization (Rs 22236.5 $ha^{-1}$) and net realization per rupee invested (2.27).

As regarded to pre-emergence application of fluchloralin @ 1000 g $ha^{-1}$ (PE) + Hand weeding at 40 DAS was most appropriate for maximization of yield attributes, growth and seed yield (985 kg $ha^{-1}$) of soybean.The minimum population and dry matter production of weeds with maximum weed control efficiency (77.34%) and the highest economic returns in terms of gross realization (Rs 32000 $ha^{-1}$), net realization (Rs 22236.5 $ha^{-1}$) and net realization per rupee invested (2.27) were also obtained under the above weed management practice.

**Table 1.** Effect of weed control treatment on total weed dry weight, weed control efficiency

| Treatment | Dose (g ha$^{-1}$) | Time of appli-cation | Total weed dry weight gm-2 | | | Weed control efficiency (%) | | |
|---|---|---|---|---|---|---|---|---|
| | | | 30 DAS | 60 DAS | 90 DAS | 30 DAS | 60 DAS | 90 DAS |
| **Crop geometry** | | | | | | | | |
| 45*5 cm | | | 14.87 | 19.66 | 23.62 | 79.08 | 76.10 | 60.39 |
| 30*10 | | | 14.63 | 19.24 | 23.39 | 79.99 | 76.45 | 60.58 |
| **SEm□** | | | 0.49 | 0.53 | 1.32 | - | - | - |
| **CD (P=0.05)** | | | NS | NS | NS | - | - | - |
| **Weed management practices** | | | | | | | | |
| $W_1$ : Weedy check | - | - | 26.84 | - | 37.74 | - | - | - |
| $W_2$ : HW twice | - | 20 & 40 DAS | 8.25 | 71 | 16.38 | 87.06 | 82.63 | 71 |
| $W_3$ : Alachlor | 1500 | PE (2 DAS) | 13.65 | 53.06 | 24.48 | 84.83 | 70.83 | 53.06 |
| $W_4$ : Alachlor | 2000 | PoE (10 DAS) | 12.33 | 53.1 | 24.44 | 85.63 | 72.63 | 53.1 |
| $W_5$ **:** Fenoxaprop-p-ethyl | 75 | PoE (10 DAS) | 16.49 | 53.84 | 24.36 | 53.07 | 63.07 | 53.84 |
| $W_6$ : Fluchloralin + HW | 80 | PoE (10 DAS) | 10.22 | 72.42 | 13.97 | 87.11 | 85.11 | 72.42 |
| **SEm□** | | | 0.22 | 0.66 | 0.66 | 0.22 | 0.27 | 0.66 |
| **CD (P=0.05)** | | | 0.59 | 1.78 | 1.78 | 0.59 | 0.73 | 1.78 |

DAS = Days after sowing; PE = Pre-emergence; PoE = Post-emergence; HW= Hand weeding

**Table 2.** Yield attributes and yields of soybean as affected by weed management practice

| Treatment | plant height (cm) at harvest | Dry matter production (g plant $^{-1}$) | Pods plant $^{-1}$ | Seed plant $^{-1}$ | 100 seed weight (g) | Seed yield (q ha$^{-1}$) | Stover yield (q ha$^{-1}$) | Net income (Rs ha$^{-1}$) | B:C ratio |
|---|---|---|---|---|---|---|---|---|---|
| **Crop geometry** | | | | | | | | | |
| 45*5 cm | 48.4 | 23.7 | 28.2 | 2.3 | 11.3 | 19.0 | 46.1 | 17749 | 2.12 |
| 30*10 | 50.9 | 24.6 | 28.6 | 2.4 | 11.5 | 19.6 | 46.2 | 18478 | 2.21 |
| **CD (P=0.05)** | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| **Weed management practices** | | | | | | | | | |
| $W_1$ : | 48.4 | 21.0 | 18.8 | 2.2 | 9.4 | 7.3 | 25.6 | 2098 | 0.25 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Weedy check | | | | | | | | | |
| $W_2$ : HW twice | 57.9 | 25.1 | 31.7 | 2.6 | 12.4 | 23.2 | 53.7 | 21452 | 2.13 |
| $W_3$ : Alachlor | 49.4 | 24.0 | 30.7 | 2.3 | 11.3 | 20.9 | 46.6 | 19311 | 2.11 |
| $W_4$ : Alachlor | 50.1 | 24.3 | 30.7 | 2.4 | 11.3 | 21.4 | 47.2 | 19733 | 2.10 |
| $W_5$ **:** Fenoxaprop -p-ethyl | 48.8 | 24.2 | 24.6 | 2.2 | 11.5 | 19.7 | 46.2 | 18139 | 2.06 |
| $W_6$ : Fluchloralin + HW | 59.2 | 25.1 | 31.9 | 2.6 | 12.5 | 23.5 | 54.5 | 22236 | 2.27 |
| **CD (P=0.05)** | 5.74 | 4.04 | 1.14 | 0.14 | 0.15 | 1.67 | 4.82 | NS | NS |

DAS = Days after sowing; PE = Pre-emergence; PoE = Post-emergence; HW= Hand weeding

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**SHORT COMMUNICATION**

# EVALUATE THE EFFICACY OF SOME NOVEL CHEMICAL INSECTICIDES ON NATURAL ENEMIES IN MAIZE

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**Abstract:** For present studies entitled "To evaluate the effect of novel insecticides on natural enemies in Maize", were conducted in randomized block design with three replications of seven treatments for years *i.e.* "*kharif*, 2011 at crop research centre, chirori, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.) 250110. The coccinellids population decreased markedly due to application of different insecticides. The effect of different treatments on coccinellids population was recorded at 15, 30, and 45 days after sowing the maize crop. The minimum population of coccinellids (2.4, 3.13 and 3.87) was recorded in chlorantraniliprole 18.5 sc@4ml/kg seed or 350ml/ha. The highest population (14.68, 10.81 and 11.67) was recorded in untreated control.

**Keywords:** Population, Chemical insecticides, Maize

## INTRODUCTION

Maize (*Zea mays)* is a plant belonging to the family of *gramineae*. It is cultivated globally being one of the most important cereal crops worldwide. Maize grain contains about 10 percent protein, 4 percent oil, 70 percent carbohydrate, 2-3 percent crude fiber, 10.4 percent albuminoids, 1.4 percent ash. Maize protein 'zein' is deficient in trypotophaneand lysine, the two essential amino acids. Maize grain has significant quantities of vitamin A, nicotinic acid, riboflavin and vitamin E. Maize is low in calcium, fairly high in phosphorus. Globally, maize is known as queen of cereals because it has the highest genetic yield potential among the cereals**.**

Maize is the third most important food grain in India after wheat and rice. In India, about 28% of maize produced is used for food purpose, about 11% as livestock feed, 48% as poultry feed, 12% in wet industry (for example starch and oil production) and 1% as seed (AICRP on Maize, 2007).

Insect-pests are the major factors responsible for low productivity of maize in India. The high yield in maize could not be released due to large number of insect pest attacking maize right sowing till harvest. Maize is attacked over 130 species of insect and pest of these four tissue borers viz. Maize stem borer, *Chilo partellus* (Swinhoe), Pink stem borer (*Sesamia inferens)*, Shoot fly (*Antherigona soccata*) and Asiatic Corn borer (*ostrinia furnacalis Guenes)* are regular and Serious pest for maize (Panwar (1995).

Potential losses due to insect pest on global basisis estimated to be in the order of 14-18%**.** Maize stem borer, *Chilo partellus* (Swinhoe) is a serious pest of maize (*Zea mays* L.) in India and distributed throughout the country.

Maize and its pest complex form maize ecosystem which also include natural enemies living on this pest. The predatory pest like spider and coccinellids feed on the larvae of stem borer of maize. The population of both, pest and natural enemies is influenced by the various a biotic factors like temperature, relative humidity, rain fall and sunshine etc. These natural enemies and abiotic factor are of major importance to affect the population of this pest.

## METHOD AND MATERIAL

The present study was carried out at crop research centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.). Trails were conducted in randomized block design with three replications of seven treatments during *Kharif*, 2011. The maize variety 'DeKalb 900 M Gold' was sown with row to row distance of 60 cm and plant to plant distance was 15 cm and plots size 5 x 3 $mt^2$. The find experiment was conducted to study the relative efficacy of different chemical insecticide against natural enemies. The two application methods i.e. seed treatment and sprays were adopted to check out the efficacy of different chemical insecticide against *Chilopartellus* (Swinhoe). under different treatments, six chemical insecticides used for seed treatment*viz.*,Thiamethoxam 25 FS@4g/kg, chlorantraniliprole18.5 SC@4ml/kg seed, chloropyrephos 20 EC@4ml/kg seed, Fipronil 5 SC@4ml/kg seed, Imidacloprid 70 FS@ 4g/kg seed andThiodicarb 75 WP@4g/kg seed, and also these six chemical insecticide used is spray with respective dose*viz.*, Thiamethoxam 25WG@ 250g/ha, chlorantraniliprole18.5 SC@350ml/ha, chloropyrephos 20 EC@1lit/hect, Fipronil 5 SC@625ml/ha, Imidacloprid 70 WG@75grm/ha and Thiodicarb 75 WP@625grm/ha. Single foliar applications of all the treatments were made with the help of a knap-sack sprayer, after 20 days of sowing.

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Population of lady bird beetles were recorded per plant at 15, 30 and 45 DAS on 5 randomly selected plants per plot.

## RESULT AND DISCUSSION

### Effect of different treatments on coccinellids population

The data on coccinellids were taken at 15, 30 and 45 DAS and are presented in table.

### Coccinellids Population at 15 DAS

The results presented in table 4.5 and shown in fig showed that coccinellids population ranged 2.4 to 14.68. The lowest population of coccinellids was recorded in treatment with chlorantrainliprolae18.5Sc @4ml/kg seed or 350ml/ha and was followed by Fipronil 5Sc @4ml/kg seed or 625 ml/ha, imidachloprid 70 Fs or 70 wg@ 4g/kg seed or 75g/ha, Thiamethoxam25 Fs or 25 WG@ 4g/kg seed or 250 g/ha, Thiodicarb 70 wp@ 4g/kg seed or 625g/ha and cloropyrephos20EC@ 4ml/kg seed or 1 lit/ha in which the population of coccinelids found was 2.4, 3.67, 5.07, 5.73, 6.67 and 7.73 respectively. The highest population 14.67 was recorded in untreated control.

### Coccinellids population at 30 DAS

The results presented in table 4.5 and shown in fig. showed that coccinellids population ranged from 3.13 to 10.81. The lowest population of coccinellids(3.13) was recorded in Chlorantraniliprole 18.5 Sc@ 4ml/kg seed or 350ml/ha followed by Fipronill 5SC@4ml/kg seed or 625 ml/ha, Thiodicarb 70WG@ 4g/kg seed or 625g/ha, Imidachloprid70Fs or 70Wg@ 4g/kg seed or 75g/ha, Thiomethoxim 25 FS or 25WG@4g/kg seed or 250g/ha, and chloropyrephos 20 Ec@4ml/kg seed or 1 lit/ha with population of 3.27, 4.53, 4.80, 5.13 and 5.87 respectively. The highest population (10.81) was recorded in untreated control.

### Coccinellids Population at 45 DAS

The data recorded on coccinellids population at 45 DAS ranged from 3.87 to 11.67. The highest population (11.67) was recorded in untreated control. The lowest population of coccinellids(3.87) was recorded in chlorantrainlipralae18.5 Sc@ 4ml/kg seed or 350ml/ha followed by Fipronil 5Sc@ 4ml/kg seed or 625 ml/ha, thiodicarb70wp@ 4g/kg seed or 75g/ha, Thiamethoxam25FS or 25wg@ 4g/kg seed or 250g/ha, chloropyrephos 20Ec@ 4ml/kg seed or 1lit/ha, imidachloprid 70Fs or 70wg@ 4g/kg seed or 75g/ha with population 4,4.6, 6.07, 6.33 and 6.40 respectively.

## CONCLUSION

The effect of different treatments on coccinellids population was recorded at 15, 30,and 45 days after sowing the maize crop. The minimum population of coccinellids (2.4, 3.13 and 3.87) was recorded in chlorantraniliprole 18.5 sc@4ml/kg seed or 350ml/ha. The highest population (14.68, 10.81 and 11.67) was recorded in untreated control.

**Table.** Effect of different treatment on coccinellids population in maize during Kharif 2011.

| Treatment No. | Name of treatment | Dose | Population of coccinellids /5 plant | | |
|---|---|---|---|---|---|
| | | | 15 DAS | 30 DAS | 45 DAS |
| $T_1$ | Thiamethoxam 25 FS | 4g/kg seed | 5.73 | 5.13 | 6.07 |
| $T_2$ | Chlorantraniliprole 18.5 SC | 4ml/kg seed | 2.4 | 3.13 | 3.87 |
| $T_3$ | Chlorpyriphos 20 EC | 4ml/kg seed | 7.73 | 5.87 | 6.33 |
| $T_4$ | Fipronil 5 SC | 4ml/kg seed | 3.67 | 3.27 | 4 |
| $T_5$ | Imidacloprid 75 FS | 4g/kg seed | 5.07 | 4.80 | 6.40 |
| $T_6$ | Thiodicarb75 WP | 4g/kg seed | 6.67 | 4.53 | 4.6 |
| $T_7$ | Control | - | 14.68 | 10.81 | 11.67 |
| **SEM ±**<br>**CD at 5%** | | | **0.53**<br>**1.65** | **0.419**<br>**1.306** | **0.44**<br>**1.39** |

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**SHORT COMMUNICATION**

# ASSESSMENT OF COPPING MECHANISM OF FARMERS TO MITIGATE DISASTER DUE TO CLIMATE CHANGE IN CHHATTISGARH PLAIN

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**Abstract :** Agriculture places heavy burden on the environment in the process of providing humanity with food and fiber, while climate is the primary determinant of agricultural productivity. Given the fundamental role of agriculture in human welfare, concern has been expressed by federal agencies and others regarding the potential effects of climate change on agricultural productivity. To examine how farmer's have been mitigating to disaster due to adverse effect of climate change. The present study was conducted in plain zone of Chhattisgarh state in the year 2013-14. For the purpose, 240 farmers of Chhattisgarh plain were interviewed. Based on the results of the interviews most of the farmers (about 90%) mentioned that they faced drought and erratic rainfall as disaster during previous 15 years. Majority of the affected farmers (about 50%) reported that their income and yield reduced due to flooding or heavy rainfall. In case of erratic rainfall, drought and frost same losses had reported by most of the affected farmers. About 61.57, 23.78, 14.42 and 8.04 per cent of affected farmers said that they had lost their livestock due to drought, environmental pollution, erratic rainfall and flood, respectively. As regards to copping mechanism practiced by farmers to mitigate losses from disaster, majority of the farmers borrowed loan to mitigate adverse effect of frost (79.14%), erratic rainfall (72.09%), drought (60.19%) and flood (38.19%).However, poor and marginalized groups were unaware regarding climate change impacts and adaptation measures. Thus, these measures were found to be event specific based on local knowledge and innovations, and not actually to cope with the impacts of climate change.

**Keywords :** Climate, Disaster, Farmers, Chhattisgarh

## INTRODUCTION

Climate change and agriculture are interrelated processes, both of which take place on a global scale (Parry *et al.*, 2007). Global warming is projected to have significant impacts on conditions affecting agriculture, including temperature, precipitation and glacial run-off (Funk *et al.*, 2008 and McCarthy *et al*., 2001). Agriculture places heavy burden on the environment in the process of providing humanity with food and fiber, while climate is the primary determinant of agricultural productivity. Given the fundamental role of agriculture in human welfare, concern has been expressed by federal agencies and others regarding the potential effects of climate change on agricultural productivity. Interest in this issue has motivated a substantial body of research on climate change and agriculture over the past decade (Lobell *et al.*, 2008, Wolfe *et al.*, 2005 and Fischer *et al.*, 2002).

Like most other developing countries, people in India are dependent to a large extent on its natural resources for livelihood and economy. Any adverse impacts on these natural resources will have repercussion on the nation's livelihood security and economy and widen the gap between the rich and the poor. Climate change is predicted by scientists to have the main impact on agriculture, economy and livelihood of the populations of developing countries and India is one of them, where large parts of the population depend on climate sensitive sectors like agriculture and forestry for livelihood.

Several studies have indicated that India is particularly vulnerable to climate change due to dependency of its most of the agriculture on monsoon rainfall. Farmers of Chhattisgarh have been also facing disasters due to adverse effect of climate change. As the understanding on global climate and its change is pre requisite to take appropriate initiatives to combat climate change. The only solution for these huge populations seems to be adequate and relevant mitigation strategies.

## METHODOLOGY

The present study was carried out in Plains of Chhattisgarh state during the year 2013-14 and 2014-15. Chhattisgarh state is divided in to 27 districts and 3 agro climatic zones namely Bastar Plateau, Chhattisgarh Plains and Northern Hills in which Four Districts of Chhattisgarh Plains were selected for present study. The study was carried out in 4 randomly selected districts of Chhattisgarh Plains. Two Blocks from each selected District were selected for the selection of villages. In this way 8 Blocks (Total 4 X 2 = 8) were selected randomly. From each selected blocks, 3 villages (Total 3 X 8 = 24) were selected randomly for the selection of respondents. From each selected village, 10 farmers were selected randomly, who had more than 15 years of farming experience.

The primary data were collected through personal interview with the help of pre-tested structured interview schedule. In addition to personal interview, group discussions were conducted in each selected village to affirm the response in group about disasters and its losses faced and by them during previous 15 years. Collected data were tabulated and

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processed by using appropriate statistical tools and presented in terms of frequency and percentage.

## RESULT AND DISCUSSION

### Disasters faced by respondents during previous 15 years

Agriculture is the mainstay in the study area, which is vulnerable at present because most of the farmers are dependent on monsoon for their agriculture. Any abnormality in monsoon may caused disasters and incurred heavy losses in agriculture productions. Table 1 shows the disasters faced by farmers during previous 15 years. About 90 per cent of the farmers faced drought and erratic rainfall as disaster during previous 15 years. Whereas, flooding and environmental pollution as disaster faced by 82.92 and 59.58 per cent of the farmers during previous 15 years, respectively. Similar findings were also reported by Pashupalak (2009).

### Type of damages/losses incurred due to disaster

Regarding damages/losses face by the farmers due disaster is given in Table 1, which shows, majority of the affected farmers (about 50%) reported that their income and yield reduced due to flooding or heavy rainfall. In case of erratic rainfall, drought and frost same losses had reported by most of the affected farmers. About 61.57, 23.78, 14.42 and 8.04 per cent of affected farmers said that they had lost their livestock due to drought, environmental pollution, erratic rainfall and flood, respectively. Loss of business was reported by few numbers of respondents in case of drought (21.30%), flood (14.07%), erratic rainfall (4.18%) and frost (2.67%).

### Copping mechanism to mitigate losses from disaster

As regards to copping mechanism practiced by farmers to mitigate losses from disaster is presented in Table 2. It shows that majority of the farmers borrowed loan to mitigate adverse effect of frost (79.14%), erratic rainfall (72.09%), drought (60.19%) and flood (38.19%). Second best copping mechanism was using saving as reported by 60.84, 58.60, 42.25, 24.12 and 22.22 per cent of the affected farmers in case of environmental pollution, erratic rainfall, frost, flood and drought, respectively.

**Table 1.** Distribution of respondents according to disaster and losses faced by them during previous 15 years

| Type of disaster | Respondents who faced disaster | | Type of damage/loss | Respondents who faced losses | |
|---|---|---|---|---|---|
| | F | P | | F | P |
| **Flooding /Heavy rainfall** | 199 | 82.92 | Loss of business/service | 28 | 14.07 |
| | | | Income reduced | 107 | 53.77 |
| | | | Family members harmed | 7 | 3.518 |
| | | | House damaged | 37 | 18.59 |
| | | | Yield reduced | 98 | 49.25 |
| | | | Livestock loss | 16 | 8.04 |
| **Erratic rainfall** | 215 | 89.58 | Loss of business/service | 9 | 4.186 |
| | | | Income reduced | 212 | 98.6 |
| | | | House damaged | 50 | 23.26 |
| | | | Yield reduced | 212 | 98.6 |
| | | | Livestock loss | 31 | 14.42 |
| **Drought** | 216 | 90 | Loss of business/service | 46 | 21.3 |
| | | | Income reduced | 215 | 99.54 |
| | | | Family members harmed | 17 | 7.87 |
| | | | Loss to irrigation/drinking water sources | 28 | 12.96 |
| | | | Yield reduced | 212 | 98.15 |
| | | | Livestock loss | 133 | 61.57 |
| **Frost** | 187 | 77.92 | Loss of business/service | 5 | 2.67 |
| | | | Income reduced | 164 | 87.70 |
| | | | Family members harmed | 37 | 19.79 |
| | | | House damaged | 143 | 76.47 |
| | | | Yield reduced | 170 | 90.91 |

| | | | | | |
|---|---|---|---|---|---|
| **Environmental pollution** | 143 | 59.58 | Income reduced | 124 | 86.71 |
| | | | Health problems | 51 | 35.66 |
| | | | House damaged | 18 | 12.59 |
| | | | Yield reduced | 140 | 97.90 |
| | | | Livestock loss | 34 | 23.78 |
| | | | Contamination of water | 43 | 30.06 |

**Table 2.** Distribution of respondents according to their copping mechanism to mitigate losses from disaster

| **Type of disaster** | **Copping mechanism to mitigate losses from disaster** | **Respondents** | |
|---|---|---|---|
| | | **F** | **P** |
| **Flooding** | Use savings | 48 | 24.12 |
| | Selling of property | 34 | 17.09 |
| | Borrowing loan | 76 | 38.19 |
| | Reduce consumption | 31 | 15.58 |
| | Government and relief and aid | 44 | 22.11 |
| | Migration | 22 | 11.06 |
| **Erratic rainfall** | Use savings | 126 | 58.60 |
| | Selling of property | 39 | 18.14 |
| | Borrowing loan | 155 | 72.09 |
| | Reduce consumption | 31 | 14.42 |
| | Government and relief and aid | 8 | 3.72 |
| | Migration | 7 | 3.26 |
| **Drought** | Use savings | 48 | 22.22 |
| | Land lease/mortgage | 14 | 6.48 |
| | Selling of property | 102 | 47.22 |
| | Borrowing loan | 130 | 60.19 |
| | Reduce consumption | 101 | 46.76 |
| | Government and relief and aid | 111 | 51.39 |
| | Migration | 92 | 42.59 |
| **Frost** | Use savings | 79 | 42.25 |
| | Selling of property | 49 | 26.20 |
| | Borrowing loan | 148 | 79.14 |
| | Government and relief and aid | 150 | 80.21 |
| | Migration | 7 | 3.74 |
| **Environmental pollution** | Use savings | 87 | 60.84 |
| | Land lease/mortgage | 11 | 7.69 |
| | Selling of land | 72 | 50.35 |
| | Filtering of drinking water | 29 | 20.27 |
| | More plantation | 38 | 26.57 |
| | Getting medical treatment | 31 | 21.67 |

## CONCLUSION

As per the above discussions it can be concluded that empowering communities with information, technological skills, education and employment is the best way to combat against disaster. A location wise action-research is therefore necessary to identify and document climate change impacts and copping strategy. The local observations described above provide a clear direction for future research and for development planning and copping management programs in different ecological regions. Policy and

program should be formulating holistic approach to mitigate adverse impact of climate change on agriculture and improve livelihood of the local communities.

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**SHORT COMMUNICATION**

# EFFECT OF PLANTING GEOMETRY AND SEEDLING DENSITIES ON LIGHT INTERCEPTION IN RICE CULTIVATION

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**Abstracts :** The optimum number of seedling densities and spacing, more number of leaves exposed to sunlight which intercepted more light. The wider spacing resulted in profuse tillering and facilitated plant for better utilization of resources, optimum planting geometries is good for growth and utilization of nutrients. It helps in better growth of plants. Higher plant height helps better LI which results in higher absorption of specific wave length of light necessary for photosynthesis that ultimately increased the yield.

**Keywords :** Effect, Seedling, Cultivation, Rice

## INTRODUCTION

Rice is life to a majority of people in Asia. The cultivation of rice represents both a way of life and a means to livelihood. For more than half of humanity, rice is life itself. Life and livelihood without rice is simply unthinkable. This grain has shaped the cultures, diets, livelihoods and economies of most of Asia. Rice is the most important cereal food crop of the world providing major source of the food energy for more than half of the human population. More than 90 per cent of the world's rice is produced and consumed in Asia where it is an integral part of culture and tradition. In world the total production of rice is 463.3 million tonnes (milled basis) in 2011–12 (Anonymous, 2012). Cropping system of a region not only relates to the distribution of area under different crops at a particular time, but it includes also the sequence of crops and intensity of cropping in relation to climate, physiography, soil type, quantity and quality of irrigation water. The potential productivity of a region is largely dependent on the climate of the area. The climatic resource of a region, in turn, affects the technological developments, management strategies as well as agricultural sustainability in general. Wheat and rice are the two major cereal crops in India grown in rabi and kharif seasons, respectively. Several studies have indicated how yield of these crops may be affected by climatic variation. High temperature at the time of sowing of wheat results in a poor stand, poor tillering, attack of root infecting fungi and pests and the early onset of flowering. All these factors depress the yield. India is second largest producer after china and has an area of over 42.2 million hectares and production of 104.32 million tones with productivity of 2372 kg ha$^{-1}$Rice occupies a pivotal place in Indian agriculture and it contributes to 15 per cent of annual GDP and provides 43 per cent calorie requirement for more than 70 per cent of Indians. It is accounts for about 42 per cent of total food grain production and 55 per cent of cereal production in the country Rice is consumed both in urban and rural areas and its consumption is growing due to high-income elasticity of demand. To meet the growing demand, a rapid increase in paddy production is needed. But, there is little scope to increase the area; hence increase in production and productivity with an improvement in efficiency of production act as a technological breakthrough to meet the growing demand. With using the appropriate method of planting geometries and seedling densities the farmers can increase their yield without increasing input cost and get higher profit.

### Effect of planting geometry, seedling density, transplanting time on light interception

Guilani *et al.* (2002) suggested that flowering behavior or photoperiod sensitivity is an independent factor and has no correlation with yield, 1000 grain weight and sterility percentage. Leaf area index remained constant and the light transmittance of canopy, photosynthetic rate and water use efficiency of the 9$^{th}$ to 13$^{th}$ leaves increased, while the transpiration rate of the leaf and the identical degree of heading decreased under lower density than that of higher density (Lin *et al.*, 2005). Whereas Light interception of crop canopy at 30 and 60 DAT was worked out by observing light intensity. Irrespective of the treatments, light interception was the highest 10 days aged seedlings than that of 14 days aged seedlings. (Verma, 2009).

The effect of increasing temperature on rice potential production is generally negative. It decreases photosynthesis, increases respiration, shortens the vegetative and grain filling period. It has been estimated that grain yield of rice decreases by 400 kg/ha, if the temperature increases by 10C in day and night time, and slightly less than 300 kg/ha when mainly night temperature increases by 10C (Penning de Vries et al., 1993). However Chowdhary and Wardlaw (1978) suggested that grain size in rice is much more stable at high temperatures than wheat.

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Though the highest and lowest temperatures occur for a short duration, yet their occurrence above or below optimum value greatly influence the plant activity (Sands et al., 1979).

Crop productivity is determined by above-ground total dry matter (ATDM) accumulation (areal total dry biomass) along with its partitioning to various parts of plants (Van der werf, 1996). ATDM and crop growth rates (CGR) are dependent on the ability of the crop canopy to (a) either the interception of photo synthetically active radiation (IPAR) (Bisco & Gallagher, 1977) which is function of leaf area index (LAI) and crop canopy architecture or (b) conversion of IPAR to ATDM, i.e., radiation use efficiency (RUE) (Sinclair & Muchow, 1999). Similarly Optimum time of transplanting is important in achieving the maximum yield potential of a variety. Xie *et al* (1996) observed that yield and total biomass of rice decreased as sowing was delayed. Munda *et al* (1994) obtained higher grain yield of rice (Khonorulla and PK-1-3) by transplanting on 15$^{th}$ June as compared with I$^{st}$ July. Roy *et al* (1994) found a rice variety which was more sensitive to photoperiod but good temperature tolerant. They recommended BR-11 for early while BR-22 and BR-23 for late sowing. Whereas Gangwar and Sharma (1997) obtained maximum grain yield by transplanting on 1$^{st}$ to 16$^{th}$ July compared to 31$^{st}$ July and 16$^{th}$ August. The most serious yield limiting factor associated with early transplanted crop is sterility. Stake and Yoshida (1978) observed that spikelet sterility is induced by high temperature.

## CONCLUSION

Generally, scented rice varieties having low tillering, less number of effective tillers, low responsive to high nutrient dose. Therefore, it is need plants are planted in optimum time with recommended number of seedlings in a proper spacing through which the plants intercept proper light and grow healthier, its ultimately help in getting higher yield as well as good quality of grain.

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**SHORT COMMUNICATION**

# A COMPARATIVE ECONOMIC ANALYSIS OF KHARIF AND SUMMER PADDY IN RAJNANDGAON DISTRICT OF CHHATTISGARH STATE

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**Abstracts:** Paddy is the major staple food which can provide a Nations population with the nationally required food security minimum of 2,400 calories per person per day (FAO, 2000). It is the staple food for about 50 per cent of population in Asia, where 90 per cent of the words rice is grown and consumed.

**Keywords:** Economic analysis, Kharif, Rajnandagaon

## INTRODUCTION

India is the 2nd largest producer of rice in the word next to china. In India rice is cultivated in 43.81 million ha. with production 96.43 million tons. This crop plays a vital role in our national food security and is a mean of livelihood for millions of rural households. In India, there is growing demand for rice due to ever burgeoning population. The rice crop is grown as principal crop under rain fed condition during kharif in whole in Chhattisgarh. Chhattisgarh popularly known as "Rice Bowl of India" occupies an area around 3.60 m. ha. with production of 1.16 mt. of paddy (urkurkar et. Al.2007).The productivity of paddy in state is 1517 kg per hectare during 2010-2011. Keeping the economic importance of paddy in district economy present study was conducted with primarily objectives of calculation of cost of cultivation and analysis of profitability in paddy (kharif & summer) production in rajnandgaon district.

## METHODOLOGY

Rajnandgaon district will be selected purposively for the study. There are 9 blocks in Rajnandgaon district, Rajnandgaon block, Ghumka village, Mohla block, Kewattola village was be selected as urban area and Mohla block, Kewattola village was be selected as Rural area purposively for represents.

The urban and rural household of Ghumka, kewattola village were categorized into two major categories *i.e.* farm households. Farm household are those who have land cultivation. Farm household was two categorized in Above Poverty Level (APL) and Below Poverty Level (BPL) household. There was being 60 respondents. 30 from each urban and rural area were being selected. The urban and rural respondents were be categorized, BPL Respondents were selected on the basis of possession of BPL card issued by government of Chhattisgarh the APL and BPL households. The household were further classified on the basis of income. The study pertains to agricultural year 2011-12. Simple mean and average method was applied for analysis.

## RESULT AND DISCUSSION

The result are analysed of following points like as cost of cultivation, production & profitability of kharif and summer paddy. These are:

**Table 1.** Cost of cultivation of kharif paddy for different categories of farmers (Rs./ha.)

| S.N. | Particulars | | Urban area | | | Rural area | | | All |
|---|---|---|---|---|---|---|---|---|---|
| | | | APL | BPL | Average | APL | BPL | Average | |
| 1. | Human labour | Family labour | 2457.74 (11.87) | 4701.90 (30.49) | 3579.82 (19.82) | 3120.21 (15.81) | 4815.12 (33.02) | 3967.67 (23.12) | 3773.75 (21.47) |
| | | Hired labour | 4558.40 (22.02) | 2214.50 (14.36) | 3386.45 (18.75) | 3561.35 (18.05) | 1802.45 (12.36) | 2681.90 (15.63) | 3034.18 (17.19) |
| 2 | Bullock power | | 0.00 (0.00) | 1000.00 (6.48) | 500.00 (2.77) | 1000.00 (5.07) | 1000.00 (6.86) | 1000.00 (5.83) | 750.00 (4.30) |
| 3 | Machine power | | 1688.47 (8.16) | 0.00 (0.00) | 844.24 (4.67) | 1575.00 (7.98) | 0.00 (0.00) | 787.50 (4.59) | 815.87 (4.63) |
| 4 | Seeds | | 1500.00 (7.25) | 1000.00 (6.48) | 1250.00 (6.92) | 1196.66 (6.06) | 1090.00 (7.48) | 1143.33 (6.66) | 1196.67 (6.79) |
| 5 | Manure & fertilizer | | 5189.82 (25.07) | 2858.72 (18.54) | 4024.27 (22.28) | 5568.41 (28.22) | 3078.09 (21.11) | 4323.25 (25.20) | 4173.76 (23.74) |
| 6 | Plant protection | | 397.33 (1.92) | 133.27 (0.86) | 265.30 (1.47) | 246.54 (1.25) | 102.67 (0.70) | 174.61 (1.02) | 219.96 (1.25) |
| 7 | Irrigation charge | | 129.25 | 0.00 | 64.63 | 256.67 | 0.00 | 128.34 | 96.49 |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | (0.62) | (0.00) | (0.36) | (1.30) | (0.00) | (0.75) | (0.56) |
| 8 | Miscellaneous | 1280.00 (6.18) | 216.66 (1.40) | 748.33 (4.14) | 516.67 (2.62) | 196.67 (1.35) | 356.67 (2.08) | 552.50 (3.11) |
| 9 | Land revenue | 12.00 (0.06) | 12.00 (0.08) | 12.00 (0.07) | 12.00 (0.06) | 12.00 (0.08) | 12.00 (0.07) | 12.00 (0.07) |
| 10 | Interest on working capital | 688.04 (3.32) | 485.00 (3.14) | 586.52 (3.25) | 681.66 (3.45) | 483.53 (3.32) | 582.60 (3.39) | 575.65 (3.33) |
| 11 | Rental value of land | 2800.00 (13.53) | 2800.00 (18.16) | 2800.00 (15.50) | 2000.00 (10.13) | 2000.00 (13.72) | 2000.0 (11.66) | 2400.00 (13.63) |
| | **Total** | **20701.05 (100.00)** | **15422.05 (100.00)** | **18061.56 (100.00)** | **19735.17 (100.00)** | **14580.40 (100.00)** | **17157.87 (100.00)** | **17600.83 (100.00)** |

**Note:** Figures in parentheses indicate percentage of the total cost of cultivation.

The cost of cultivation of paddy crop is presented in Table 1. Table revealed that the total cost of cultivation of paddy in urban and rural area is found on an average Rs. 18061.55and Rs.17157.87 per ha.

The cost of cultivation of paddy crop in both the family (APL and BPL) of urban area is estimated as Rs.20710.05 and Rs.15422.05. The cost incurred on different operations shows large difference in the cost between both families. The total cost incurred on family labour Rs.2457.74 in APL family while Rs. 4701.90 in BPL family but in case of hired labour APL family incurred Rs. 4558.40 and Rs.2214.50 per ha. by BPL family. This figure shows high price different (50 percent) in the both urban APL and BPL family. The APL family spends more amount of total cost of cultivation on machine power, manure and fertilizer and some miscellaneous operations, accounted (40 percent) cost in APL family. Major cost incurred by BPL family on bullock power, seeds and manure and fertilizer. This three major operations accounted (31 percent) of total cost of cultivation of BPL family in urban area.

It is concluded form the table that APL family of urban area spends more amounts in the same operations of BPL family.

Similarly, cost of cultivation of paddy crop in both the family (APL and BPL) of rural area is estimated as Rs.19735.17 and 14580.40.per ha. The costs incurred on different operations have large difference in the cost between both the families. The total cost incurred on family labour estimatedRs.3120.20 in APL family while Rs. 4815.12 in BPL family but in case of hired labour APL family incurred Rs. 3561.35 and Rs.1802.45 per ha. incurred by BPL family. This figure shows high price difference in the both rural APL and BPL family. The APL families spend more amount of total cost on machine power, manure fertilizer and seeds operations. This three major operations accounted (42 percent) of total cost. Cost incurred by BPL family on bullock power, seeds and manure and fertilizer operations accounted 35 percent of total cost of cultivation of BPL family in rural area.

**Table 2.** Economics of kharif paddy production under different categories of farmers

| S. N. | Particulars | Urban Area | | | Rural Area | | | All Average |
|---|---|---|---|---|---|---|---|---|
| | | APL | BPL | Average | APL | BPL | Average | |
| 1 | Input cost (Rs. /ha.) | **20701.05** | **15422.05** | **18061.56** | **19735.17** | **14580.40** | **17157.87** | **17600.83** |
| 2 | Production (qlt/ha.) | | | | | | | |
| | a. Main product | 39.96 | 35.66 | 37.81 | 38.86 | 36.85 | 37.86 | 37.84 |
| | b. By product | 21.00 | 20.00 | 20.5 | 21.00 | 19.00 | 20.00 | 20.25 |
| 3 | Returns (Rs/ha.) | | | | | | | |
| | a. Main product | 50000.00 | 44575.00 | 47287.50 | 48575.00 | 46062.50 | 47318.75 | 47353.13 |
| | b. By product | 630.00 | 600.00 | 615.00 | 630.00 | 570.00 | 600.00 | 607.50 |
| 4 | Gross returns (Rs./qtls) | 50630.00 | 45025.00 | 47827.50 | 49175.00 | 46632.50 | 47903.75 | 47865.63 |
| 5 | Net return (Rs. /ha.) | 29928.95 | 29602.95 | 29765.95 | 29439.83 | 32052.10 | 30745.88 | 30264.80 |
| 6 | Cost of production(Rs./ qtls) | | | | | | | |
| | Main product | 518.04 | 432.47 | 475.26 | 507.85 | 395.66 | 451.76 | 463.51 |
| 7 | Input-output ratio | **1:2.45** | **1:1.92** | **1:2.2** | **1:2.49** | **1:3.19** | **1:2.49** | **1:2.34** |

Economics of mansoon paddy production under different categories of farmer is presented in Table 2. The table shows that per ha. input cost on paddy cultivation on an average is estimated asRs.18061.55 and Rs.17157.87 per ha. In urban and rural area. The perha. yield of paddy on an average was 37.81 qtls and 37.85 qtls. per ha. the total value on an average is estimated to be Rs. 47287.50 in urban and Rs.47318.75 rural area. The average gross return is observed as Rs.47287.50 per ha.which ranges farm Rs.50000.00APL family to Rs. 44575.00 in BPL family of urban area. The average gross return is observed as Rs.47318.75 which ranges from Rs.49175 an Rs.46632.50 at APL and BPL family of rural area. It shows that there is not much difference between the gross return at rural and urban level. The value of net return is calculated quite high of rural area i.e. Rs.29765.95. The input-output ratio is worked out to on an average 1:2.2 to 1:2.49 in urban and rural area. This shows increasing treads in rural area of APL and BPL family as compared to urban area.

**Table 3.** Cost of cultivation of summer paddy at sample household (Rs./ha.)

| S.N. | Particulars | Urban area | Rural area | Average |
|---|---|---|---|---|
| | Human labour | APL | APL | |
| 1 | a. Family labour | 2247.74 (11.67) | 2120.21 (11.70) | 2183.98 (11.69) |
| | b. Hired labour | 3458.40 (17.96) | 3421.35 (18.88) | 3439.88 (18.40) |
| 2 | Bullock power | 0.00 (0.00) | 1000.00 (5.52) | 500.00 (2.68) |
| 3 | Machine power | 1688.47 (8.77) | 1575.00 (8.69) | 1631.74 (8.73) |
| 4 | Seeds | 1500.00 (7.79) | 1196.66 (6.60) | 1348.33 (7.22) |
| 5 | Manure & fertilizer | 5089.82 (26.43) | 5153.41 (28.44) | 5121.62 (27.40) |
| 6 | Plant protection | 217.33 (1.13) | 186.54 (1.03) | 201.94 (1.08) |
| 7 | Irrigation charge | 329.25 (1.71) | 316.67 (1.75) | 322.96 (1.73) |
| 8 | Miscellaneous | 1280.00 (6.65) | 516.67 (2.85) | 898.34 (4.81) |
| 9 | Land revenue | 12.00 (0.06) | 12.00 (0.07) | 12.00 (0.06) |
| 10 | Interest on working capital | 632.44 (3.28) | 619.46 (3.42) | 625.95 (3.35) |
| 11 | Rental value of land | 2800.00 (14.54) | 2000.00 (11.04) | 2400.00 (12.84) |
| | **Total** | **19255.45 (100.00)** | **18117.97 (100.00)** | **18686.74 (100.00)** |

**Note:** Figures in parentheses indicate percentage of the total cost of cultivation.

Summer paddy cultivation of sample household presented in Table 3. It is noted that the only APL family both the area take summer crop of paddy due to availability of resource on their field. The total cost of cultivation summer paddy in urban area estimated Rs.19255.45 and Rs. 18117.97 in rural area. It is observed from the table that per ha. manure and fertilizer cost is worked out to Rs.5089.82 (26.43 percent) in APL family in urban area, while it is estimated as Rs.5153.41 (28.44 percent) in APL family in rural area. per ha. expenditure on family labour 2247.74 (11.67 percent) and hired labour Rs.3458.40 (17.96 percent) in urban area. In case of rural area, family labour accounted Rs.2120.21 (11.70 percent) and Rs. 3421.35 (18.88 percent) respectively. It concluded form the figure that the both the family of area spend of similar amount on human labour per ha. bullock power, machine power, seeds and miscellanies items, observed as Rs.4467.47 (23.20 percent) in urban area, while this figure of same operations in rural area is observed as Rs.4287.33 (23.66 percent).

Rental value of land as an important fixed cost included in the cost of cultivation of paddy crop. The rental value of land is estimated as Rs.2800.00 per ha. (14.54 percent) in urban area while it is estimated as Rs. 2000.00 (11.04 percent) in rural area respectively.

**Table 4.** Economics of summer paddy production under different categories of farmers

| S.N. | Particulars | Urban APL | Rural APL | Average |
|---|---|---|---|---|
| 1 | Input cost (Rs. /ha.) | **19255.45** | **18117.97** | **18686.74** |
| | Production (Qlts/ha.) | | | |

| | | | | |
|---|---|---|---|---|
| 2 | a. Main product | 38.96 | 37.86 | 38.41 |
| | b. By product | 19.00 | 18.00 | 18.50 |
| 3 | Returns (Rs/ha.) | | | |
| | a. Main product | 48700.00 | 47325.00 | 48012.50 |
| | b. By product | 570.00 | 540.00 | 555.00 |
| 4 | Gross returns (Rs. /ha.) | 49270.00 | 47865.00 | 48567.50 |
| 5 | Net return (Rs. /ha.) | 30014.55 | 29747.03 | 29880.76 |
| 6 | Cost of production(Rs./qtls) | | | |
| | Main product | 506.72 | 478.55 | 492.64 |
| 7 | Input-output ratio | **1:2.55** | **1:2.64** | **1:2.60** |

Economics of summer paddy production under different categories of farmer is presented in Table 4. The table showed that per ha. input cost on summer paddy cultivation calculated Rs.19255.45and Rs.18117.97 per ha. in APL family of urban and rural area. The per ha. yield of paddy calculated 38.96qtlsurban and 37.86 qtls. in rural area. The total value production on an average estimated to be Rs. 48700.00 per ha. in urban and Rs.47325.00 per ha. rural area. The gross return is observed as Rs.49270 per ha. and Rs.47865.00 per ha. In urban and rural area respectively.Net return is worked out Rs.30014.55 and 29747.03 per ha. in urban and rural. The input-output is worked out 1:2.55 to 1:2.64 in urban and rural area. It shows increasing treads in rural area of APL family as compared to urban area.

## CONCLUSION

The forgoing analysis of paddy cultivation indicates that the paddy is the important major kharif crops in the study area. The average cost of cultivation of kharif and summer paddy was estimated to be Rs. 17600.83 and18686.74 per ha. The average gross income of kharif and summer paddy was estimated to be Rs. 47865.63 and 48567.50 per ha. The average net income of kharif and summer paddy was estimated to be Rs. 30264.80 and 29880.76 per ha respectively at sampled farm of kharif and summer paddy growing in the study area.

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**SHORT COMMUNICATION**

# EFFECT OF PULSING WITH CHEMICALS ON POST-HARVEST QUALITY OF GLADIOLUS (*GLADIOLUS HYBRIDUS* HORT.) CV. PEATER PEARS

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**Abstract :** An experiment was conducted to find out the effect of pulsing solutions on postharvest life of gladiolus cv. Peater Pears cut spikes. Among all the pulsing treatments , treatment, $T_4$ (20% Sugar + 200ppm STS + 200 ppm GA3) gave maximum vase life, floret size, minimum days to open basal floret, maximum floret longevity, floret opening percentage while treatment $T_7$ (20% sucrose + 300 ppm $Al_2SO_4$ + 200 ppm $GA_3$) attained maximum number of floret, floret weight and floret open at a time during the study.

**Keywords :** Gladiolus, Pulsing, Spike, Vase life

## INTRODUCTION

Gladiolus, belongs to the family Iridaceae, is an important boulbous flower plant, grown for its fascinating spikes, which open gradually from base to the top. It is cultivated all over the country to meet out increasing cut flower demand. Gladiolus cut flowers are highly perishable and vulnerable to large postharvest losses. The spikes last for only 6-7 day when placed in water (Murali and Reddy, 1993) which is too less a postharvest life for marketing of gladiolus for distant market. With increasing demand of floriculture products in and out of the country, there is a need to provide suitable transport system and post-harvest conditions. Moreover, due to physiological and pathological effects during the post-harvest handling approximately 20% of the total fresh products are lost in between the time of transportation. Therefore, by growing the volume of export of floricultural products the research focuses on post-harvest methods are in demand. (Usman Farooq *et al*. 2004; Panhwar 2006) Therefore, the present investigation was conducted to find out the effective pulsing solution duration to prolong the vase life of gladiolus cv. Peater Pears.

## MATERIAL AND METHOD

The present investigation was carried out at the Department of Horticulture, S.V.B.P.U.A. & T., Meerut, during 2013-2014. The spikes were harvested in the early morning hours when lower most 1-2 florets showed colour and later on brought to the laboratory in bucket containing water. The maximum and minimum laboratory temperatures fluctuated between 20-25 °C and 17-20 °C, respectively during the course of experimentation.
The uniformity in spike length was maintained by giving a slant cut 25 cm below the lower most floret. The spikes were placed in different pulsing solutions including control (Tap water) for 24 after that the spikes were kept in deionized water for vase life studies except control. The experiment was laid out in a completely randomized design (CRD) consisting of nine treatments *viz.*, $T_1$-20% Sugar + 100ppm STS. $T_2$ -20% Sugar + 200ppm STS, $T_3$-20% Sugar + 200ppm STS + 100ppm $GA_3$,$T_4$ -20% Sugar + 200ppm STS + 200ppm $GA_3$, $T_5$-20% Sugar + 300ppm $Al_2SO_4$, $T_6$-20% Sugar + 300ppm $Al_2SO_4$ +100ppm $GA_3$, $T_7$, 20% Sugar + 300ppm $Al_2SO_4$ +200ppm $GA_3$. $T_8$, 20% Sucrose+ 200ppm 8HQC and $T_9$, control (with tap water), and were replicated three times. Observations were recorded on vase life, floret size, days to open basal floret, floret longevity, number of floret open at a time, floret opening percentage, floret weight and floret open at a time percentage.

## RESULT AND DISCUSSION

All pulsing treatments were found to be superior over control for majority of the characters in terms of postharvest quality of gladiolus cut spikes (Table1). The maximum vase life (7.49 day) was observed under the treatment T4 followed by (7.29 days) under the treatment T5 and it was minimum (3.75 days) observed in control. It may be due to the exogenous supply of sucrose which replaced the depleted endogenous carbohydrate, utilized during the postharvest life of flower and thereby enhanced vase life (Kumar, 2005).Similar results also reported by Kumar *et al*. (2007) in gladiolus. Significant variation was observed among the treatments in terms of floret size and it was maximum (6.97 cm) observed in the treatment $T_4$ followed by (6.83 cm) under the treatment $T_8$ and minimum floret size (4.30 cm) was observed under control. Sucrose with STS and $GA_3$ had shown significant effect on days to open basal floret and it was minimum (1.37 days) recorded in treatment $T_4$ and the maximum days to open basal floret (3.40 days) noted under the treatment $T_9$ when spikes were kept in tap water. Treatment $T_4$ attained maximum (3.72 days) floret

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longevity followed by (3.59 days) under the treatment $T_7$ and it was minimum (1.62 days) reached under control. It is well known that sugar supply, increases the longevity of many cut flowers, since they act as a source of nutrition for tissues approaching carbohydrate starvation. It my also act as osmotically active molecule thereby leading to the promotion of subsequent water relations (Ichimura, and Hismatsu, 1999). Treatment $T_7$ produced maximum number of florets open at time and treatment and T9 exhibited minimum number of florets open at time. Floret opening percentage was also affected by different treatments and treatment $T_4$ showed maximum floret opening percentage and control exhibited minimum number of floret opening percentage. The increase in florets opening and longevity by mineral salts might be due to the fact that mineral salts increase the osmotic concentration and pressure potential of the petal cells thus improving their water balance and quality of cut flower spike (Halevy, 1976). The use of sugar and $GA_3$ has also been earlier reported useful for gladiolus (De *et al., 1996).* Among the treatments showed significant variation in terms of floret weight and found that treatment $T_7$ gained maximum floret weight (14.52 gm) which was found statistically at par with treatment $T_{4,}$ (14.16 gm) and minimum floret weight (10.85 gm) found in control. Floret open at a time in percentage also differed each other among the treatments and treatmentT7 gave maximum floret open at a time (36.87 percent) followed by, (35.42 percent) under the treatment T4 and minimum floret opening percentage at a time (16.06 percent) recorded in control. The increase in florets opening and longevity by mineral salts might be due to the fact that mineral salts increase the osmotic concentration and pressure potential of the petal cells thus improving their water balance and quality of cut flower spike (Halevy, 1976).

**Table 1.** Effect of pre storage (pulsing) on post harvest quality of gladiolus

| | Treatment | Vase life | Floret size(cm) | Days to open basal floret | Floret longevity (days) | No. of floret at a time | Floret opening % | Floret wt.(gm) | Floret open at a time % |
|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | 20% Sugar + 100ppm STS | 5.40 | 5.59 | 1.89 | 3.10 | 5.35 | 60.47 | 13.67 | 30.87 |
| $T_2$ | 20% Sugar + 200ppm STS | @6.27 | 5.92 | @@1.93 | 3.33 | 5.69 | 64.07 | 13.85 | 31.73 |
| $T_3$ | 20% Sugar + 200ppm STS + 100ppm $GA_3$ | 6.78 | 6.19 | @1.65 | 3.39 | 6.65 | 66.65 | 13.92 | 33.16 |
| $T_4$ | 20% Sugar + 200ppm STS + 200ppm $GA_3$ | **7.49** | **6.97** | **1.37** | 3.72 | 7.06 | 77.87 | 14.16 | 35.42 |
| $T_5$ | 20% Sugar + 300ppm $Al_2SO_4$ | 7.29 | 6.65 | 1.46 | 3.18 | 6.36 | 63.80 | 13.33 | 31.67 |
| $T_6$ | 20% Sugar + 300ppm $Al_2SO_4$ +100ppm $GA_3$ | @6.21 | 5.85 | @1.67 | 3.09 | 6.99 | 64.53 | 12.64 | 32.83 |
| $T_7$ | 20% Sugar + 300ppm $Al_2SO_4$ +200ppm $GA_3$ | @6.17 | 6.18 | @@1.93 | 3.59 | **7.23** | 72.17 | **14.52** | **36.87** |
| $T_8$ | 20% Sucrose+ 200ppm 8HQC | 5.65 | 6.83 | @@1.95 | 2.92 | 6.69 | 64.75 | 11.46 | 30.86 |
| $T_9$ | Control | 3.75 | 4.30 | 3.40 | 1.62 | 3.90 | 32.16 | 10.85 | 16.06 |
| | **MSE** | **0.022** | **0.015** | **0.089** | **1.069** | **0.801** | **0.854** | **0.104** | **0.120** |
| | **CD at 5%** | **0.121** | **0.099** | **0.243** | **0.844** | **0.731** | **0.755** | **0.264** | **0.283** |

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