Journal of Plant Development Sciences

(An International Monthly Refereed Research Journal)

Volume 7 **Number 10** **October 2015**

Contents

A PRELIMINARY STUDY ON THE MOSS FLORA OF KISHTWAR, J&K (NORTH-WEST HIMALAYA)

Mudasir Riaz, Anu Sharma* and Anima Langer

Department of Botany, University of Jammu, Jammu-180 006
Department of Botany, University of Jammu,
B.R. Ambedkar Road, Jammu-180 006.
Email: anu4botany@gmail.com

Received-06.09.2015, Revised-08.10.2015

Abstract: This paper is the first attempt to enlist the moss flora of Kishtwar (North-West Himalaya). A total of 17 mosses belonging to 8 orders, 12 families and 17 genera have been collected from diverse habitat, altitude and substrate pH.

Keywords: Hypnobryales, North-West Himalaya, Jammu & Kashmir state, Kishtwar, Moss flora.

INTRODUCTION

Being one of the 17 mega diversity centers of the world (Mittermeier *et al*., 1997), India exhibits tremendous climatic, altitudinal and habitat diversity. The ecological habitats vary from humid tropical Western Ghats to hot deserts of Rajasthan and from cold deserts of Ladakh to warm coasts of Peninsular India and moist Eastern Himalayas to moderate climatic zones of central India.

Bryophytes constitute one of the richest groups of plants in India and inhabit a wide range of habitats. A recent checklist of bryophytes compiled for India comprised of 2489 taxa representing 1786 species in 355 genera of mosses, 675 species in 121 genera of liverworts and 25 species in 6 genera of hornworts (Dandotiya *et al*., 2011). Eastern Himalayas harbor richest bryoflora, followed by South India and Western Himalaya (Singh, 1997; Srivastava, 1998; Vashistha, 1998).

The state of Jammu and Kashmir which forms a part of North-West Himalaya offers suitable climatic conditions for bryodiversity. Despite its richness, most of the areas are totally un/under explored for its bryoflora. Only 20 hepatic taxa have so far been reported from Ladakh division of the state (Kashyap, 1929; Tanwir et al., 2006; Dolma and Langer, 2012; Dolma and Langer, 2013) and 48 from Kashmir region (Kashyap, 1929; Robinson, 1965; Kaul and Dhar, 1968; Srivastava, 1979; Banday *et al*., 1998). Preliminary exploration of a few areas of Jammu region by Langer and her associates (Langer and Tanwir, 2002; Langer *et al*., 2003; Tanwir and Langer, 2004; Tanwir, 2005; Tanwir *et al*., 2008) has revealed their richness in bryodiversity. The region comprises 10 districts, of which two (Jammu and Samba) are totally plain, seven (Udhampur, Rajouri, Reasi, Poonch, Doda, Kishtwar and Ramban) totally hilly and one (Kathua) partially hilly and partially plain. Although systematic studies on the hepatic flora of several districts (Jammu, Udhampur, Poonch and Rajouri) have been undertaken in the past, data available for moss flora of the region is almost negligible except moss diversity of Patnitop (Udhampur district) (Bhandari *et al*., 2008). As far as district Kishtwar is concerned, it has not attracted the attention of bryologists, part of this district was previously explored for its tracheophyte diversity (Kumar *et al*., 2009) and thalloid hepatics (Sharma and Langer, 2012; Vanderpoorten and Goffinet, 2009). An attempt was, therefore, made to study the bryoflora of this area covering an altitudinal range of 1005 m to 2316 m. The exploration yielded a total of 27 taxa including 10 liverworts and 17 mosses. Present paper includes the information regarding various ecological aspects of the mosses only. Data collected for the hepatic taxa will be communicated separately.

MATERIAL AND METHOD

Diverse habitats such as epilithic, non-epilithic, epiphytic and aquatic lying between 1005 m to 2316 m in Kishtwar district of Jammu region (J & K) were thoroughly scanned for their bryodiversity through periodic field trips (Table1).Data on various ecological parameters (habitat, altitude, soil pH, etc) were collected in the field notebook. The collected taxa were identified on the basis of morphology and anatomy of various gametophytic (branching pattern, habit and habitat, whole mount of leaf, V.S of axis, arrangement of leaves etc) and sporophytic (position and shape of sporophyte, peristome etc) characters.

RESULT

District Kishtwar, one of the ten districts of Jammu division (J &K) is situated between 33° 10´ and 33° 25´ latitude and 75° 25´ and 76° 10´ longitude. Altitude of the district ranges from 914 m to 6600m above sea level. Many high altitude areas of the district experience snowfall during December and January when the temperature dips below 0° C. It is bounded on the North by Kashmir and Zanskar

*Corresponding Author

valleys, South by Bhaderwah and Doda, East by Himachal Pradesh and West by Anantnag and Ramban. This hilly district has largely remained unexplored with respect to its bryodiversity, although Sharma and Langer (2012), undertook exploration of few areas lying between 1500 m to 3500 m altitude for its liverwort diversity. The present paper is the first attempt to document the moss flora of the district falling between 1005 m to 2316 m.

The moss taxa collected presently represent 8 orders, 12 families and 17 genera (Table 2; Figs. Plate I & II). It is evident from the Table that the largest order with respect to number of families represented in the present collection is Hypnobryales (3 families), then Pottiales and Eubryales with 2 families each and remaining five orders (Fissidentales, Funariales, Grimmiales, Polytrichales and Dicranales) are represented by a single family each. The only study on moss flora of Jammu region is that of Bhandari *et al*. (2008) who studied the moss diversity of Patnitop and its adjoining areas (Udhampur district) and reported 40 taxa belonging to 25 genera, 8 orders and 16 families. Out of the 17 taxa collected presently, only five (*Hymenostylium recurvirostre, Bryum cellulare, Funaria hygrometrica, Ditrichum heteromallum* and *Fissidens bryoides*) were common with those collected from Udhampur district by Bhandari *et al*. (2008). Comparison of the ecological (habitat, pH and altitude) data collected presently and earlier for these taxa has been presented in Table 3.

DISCUSSION

Mosses are known to inhabit wide range of habitats (soil, rock, rotten wood, animal dung, burnt stumps, stream sides, calcareous soil, acidic soil, aquatic, damp areas, rock crevices etc.), pH and altitudinal range. They have either broad ecological amplitude or specific micro-environmental conditions. They play a significant role in ecosystem dynamics (Kashyap, 1920). It is evident from Table 2 that mosses have been collected presently from only two habitats (epilithic and non-epilithic) and none from epiphytic or aquatic habitat. Besides epilithic and non-epilithic, Bhandari *et al*. (2008) also collected 7 epiphytic mosses. Table 2 also reveals that the non-epilithic (11) taxa outnumbered the epilithic (6) ones. Similar trend was recorded by Bhandari *et al*. (2008) who collected 25 non-epilithic and 6 epilithic taxa.

Altitude is also known to play a vital role in bryophytic distribution (Srivastava, 1998; Kashyap, 1920). In Punjab plains, mosses become luxuriant between 1525-2135 m and number gradually increases from plains to mountains (Dixon and Badhwar, 1938) . Chopra (1975) however, identified an altitudinal range of 1800-2400 m as the most suitable for the growth of mosses in Western Himalayas like optimum altitudinal range (1824-2432 m) of hepatic richness observed by Srivastava (1998). At higher elevations, there is again decline in their number. The moss taxa collected presently also reveal correlation with altitude. With increase in altitude there is increase in number of species.

As it is clear from Table 2, only one species (*Hymenostylium recurvirostre*) was collected from the lowest altitude (1010 m) and maximum number (8) from an altitudinal range of 1401-1600 m. Similar observations have been made from Udhampur district. Maximum (25) number of species had been collected between 1901-2100 m and minimum (9) from the lowest (500-1200 m) altitude.

Another ecological factor which influences the bryophytic distribution is substrate pH. Moss taxa studied presently were found inhabited the substrata having pH 6.8-8.1. During this study, they were collected neither from acidic nor highly alkaline soils. On the other hand, Bhandari *et al*. (2008) have collected moss taxa from soils with 4.7 as well as 9.2 pH.

Perusal of Table 2 reveals that

(a) Out of 17 taxa, majority of species (10) grew exclusively on alkaline soil (7.4 and above).

(b) 5 taxa occurred on the substratum with neutral pH (6.9-7.2).

(c) 2 taxa grew on slightly acidic pH (6.8).

Figures

Peristome teeth of *Barbula tortelloides* (Fig. a), *Funaria hygrometrica* (Fig. b)

Morphology of *Barbula tortelloides* (Fig. c), *Funaria hygrometrica* (Fig. d), *Rhodobryum roseum (*Fig. e), *Fissidens bryoides* (Fig. f), *Encalypta vulgaris* (Fig. g), *Hyophila rosea* (Fig. h), *Ditrichum heteromallum* (Fig. i), *Brachythecium populeum* (Fig. j), *Bryoerythophyllum wallichi* (Fig. k), *Grimmia ovalis* (Fig. l), *Hymenostylium recurvirostre* (Fig. m), *Hypnum cupressiforme* (Fig. n), *Oxystegus cylindricus* (Fig. o), *Taxithelium kerianum* (Fig. p), *Mnium marginatum* (Fig. q).

Table 1. List of the bryophyte taxa collected from various sites.

Locality	Altitude (m)	Taxa collected
Cherhar	1371	*Reboulia hemispherica, Marchantia paleacea, Mnium marginatum*
Dool	1524	*Marchantia paleacea, M. polymorpha, Pellia endivaefolia, Bryum cellulare, Funaria hygrometrica, Atrichum undulatum*
Dool dam site	1402	*Reboulia hemispherica*
Ekhala	1700	*Plagiochasma appendiculatum, Pellia endivaefolia*
Galhar	1706	*Conocephalum conicum, Pellia endivaefolia*
Godrashnag	1524-1706	*Plagiochasma appendiculatum, Reboulia hemispherica, Dumortiera hirsuta, Bryoerythrophyllum wallichi, Rhodobryum roseum, Fissidens bryoides, Taxithelium kerianum*
Hasti	1280	*Plagiochasma appendiculatum, Reboulia hemispherica*
Hudri	1249	*Marchantia paleacea*
Hullar	1250	*Reboulia hemispherica, Marchantia paleacea, Oxystegus cylindricus*
Keru	1706	*Conocephalum conicum, Dumortiera hirsuta, Preissia quadrata, Pellia endivaefolia, Brachythecium populeum*

Kuadya	1016	*Conocephalum conicum, Pellia endivaefolia*
Kumran	2316	*Reboulia hemispherica*
Kwarh	1676	*Plagiochasma appendiculatum, Reboulia hemispherica, Marchantia paleacea, M. polymorpha, M. subintegra, Preissia quadrata, Pellia endivaefolia, Hypnum cupressiforme*
Mugalmaidan	1005	*Conocephalum conicum, Marchantia paleacea, Pellia endivaefolia, Hymenostylium recurvirostre*
Nageni	1219	*Marchantia paleacea, Pellia endivaefolia, Grimmia ovalis*
Parwajan	1492	*Plagiochasma appendiculatum, Reboulia hemispherica, Encalypta vulgaris, Hyophila rosea*
Poohie	1280	*Reboulia hemispherica*
Sarthal	1584	*Marchantia paleacea, Pellia endivaefolia, Ditrichum heteromallum*
Shalimar	1280	*Reboulia hemispherica*
Wardi	1270	*Marchantia paleacea*
Waserkund	1584	*Reboulia hemispherica, Marchantia paleacea, Pellia endivaefolia, Barbula tortelloides*

Table 2. Habitat diversity of various moss taxa collected

Order/ Family	Taxa	Site of collection	Altitude (m)	Habitat	pH
A.POTTIALES					
a)Pottiaceae	*Barbula tortelloides* C. Muell.	Waserkund	1280	Cemented wall fully/partially exposed to sunlight	7.6
	Hyophila rosea Williams	Parwajan	1490	Moist soil partially exposed to sunlight	7.9
	Bryoerythrophyllum wallichi (Mitt.) Chen	Godrashnag	1706	Rock surface fully exposed to sunlight	7.1
	Hymenostylium recurvirostre (Hedw.) Dix.	Mughal maidan	1010	Moist soil partially exposed	7.8
	Oxystegus cylindricus (Brid.) Hilp.	Hullar	1250	Soil partially exposed	7.8
b)Encalyptaceae	*Encalypta vulgaris* Hedw.	Parwajan	1493	Soil fully exposed to sunlight	8.1
B.EUBRYALES					
a)Bryaceae	*Bryum cellulare* Hook.	Dool	1524	Moist soil fully exposed to sunlight	7.4
	Rhodobryum roseum (Hedw.) Limpr.	Godrashnag	1706	Soil partially exposed to sunlight	6.8
b)Mniaceae	*Mnium marginatum* (With.) P.Beauv.	Cherhar	1371	Soil partially exposed	7.6
C.FUNARIALES					
Funariaceae	*Funaria hygrometrica* Hedw.	Dool	1524	Soil partially exposed to sunlight	6.8
D.FISSIDENTALES					
Fissidentaceae	*Fissidens bryoides* Hedw.	Godrashnag	1524	Wet rock surface	7.1
E.HYPNOBRYALES					
a)Brachitheciaceae	*Brachythecium populeum* (Hedw.) Schimp.	Keru	1700	Rock surface fully exposed	7.2
b)Hypnaceae	*Hypnum cupressiforme* Hedw.	Kwarh	1676	Wet rock surface	6.9
c)Sematophyllaceae	*Taxithelium kerianum* (Broth.) Broth.	Godrashnag	1524	Cemented wall fully exposed	7.1
F.GRIMMIALES					
Grimmiaceae	*Grimmia ovalis* (Hedw.) Lindb.	Nageni	1219	Soil partially exposed to sunlight	7.6

G.DICRANALES					
Ditrichaceae	*Ditrichum heteromallum* (Hedw.) Britt.	Sarthal	1584	Soil partially exposed	7.6
H.POLYTRICHALES					
Polytrichaceae	*Atrichum undulatum* (Hedw.) P. Beauv.	Dool	1524	Moist soil fully exposed to sunlight	7.8

Table 3. Comparison of common moss taxa of Kishtwar with Patnitop and its adjoining areas.

Taxa	Habitat		Altitude (m)		pH	
	Present study	Bhandari et al. (2008)	Present study	Bhandari et al. (2008)	Present study	Bhandari et al. (2008)
Hymenostylium recurvirostre	Non-epilithic	Epilithic	1010	1530	7.8	7.8
Funaria hygrometrica	Non-epilithic	Non-epilithic	1524	2000	6.8	7.8
Fissidens bryoides	Epilithic	Non-epilithic	1524	2000	7.1	8.2
Ditrichum heteromallum	Non-epilithic	Non-epilithic	1584	1650	7.6	9.2
Bryum cellulare	Non-epilithic	Non-epilithic	1524	2000	7.4	8.4

ACKNOWLEDGEMENT

The authors are thankful to the Head, Department of Botany, University of Jammu, Jammu for providing necessary laboratory facilities and to Dr. P. L. Uniyal of University of Delhi, Delhi for his help in verification of plant identification.

REFERENCES

Banday, F.A.; Naqshi, A.R. and Dar, G.H. (1998). Liverworts (Hepaticae) of Kashmir Himalaya- A Floristic Survey. Oriental Science, 3: 1-6.

Bhandari, M.; Langer, A. and Tanwir, M. (2008). Preliminary studies on the moss diversity in Patnitop and its adjoining areas (J & K), North West Himalaya, India. Geophytology, 37: 65-73.

Chopra, R.S. (1975). Taxonomy of Indian Mosses: PID, C. S. I. R. New Delhi.

Dandotiya, D.; Govindapyari,H.; Suman, S. and Uniyal, P.L. (2011). A Checklist of the bryophytes of India. Archive for Bryology : 88.

Dixon, H.N. and Badhwar, R.L. (1938). Some new North-Western Himalayan mosses. Records of the Botanical Survey of India, 12: 163-179.

Dolma, K. and Langer, A. (2012). Studies on the Bryodiversity of Ladakh (Trans- Hiamalya) : I, Current status of Hepatic flora of Ladakh. Proceedings of the National Academy of Sciences, India, Sect. B. Biological Sciences, 82(4): 537-541.

Dolma, K. and Langer, A. (2013). Studies on the Bryodiversity of Ladakh (Trans- Hiamalya) : III. Riccia frostii Aust.: an addition to the hepatic flora of Ladakh. Geophytology, 42(1): 65–69.

Kashyap, S.R. (1920). Distribution of liverworts in the Western Himalayas. Journal of Indian Botanical Society, 1: 149-157.

Kashyap, S.R. (1929 and 1932). Liverworts of the Western Himalayas and the Panjab Plains. Part I and II. Researchco Publications, Delhi, India.

Kaul, R.K. and Dhar, G.L. (1968). Some Bryophytes of Kashmir valley. Kashmir Science, 5: 233 – 237.

Kumar, S., Khan, M. and Hamal, I.A. (2009). Diversity of vascular plants of Kishtwar High Altitude National Park, Jammu and Kashmir (Northwest Himalaya). The Ecoscan, 3(1& 2): 177-187.

Langer, A. and Tanwir, M. (2002). Liverwort and Hornwort Flora of Tehsil Mendhar (North- West Himalaya), India. Geophytology, 30 (1&2): 81–84.

Langer, A.; Gupta, S. and Tanwir, M. (2003). Preliminary survey of Jammu District (North- West Himalaya) for liverwort and hornwort Flora. Geophytology, 31 (1&2): 87–89.

Mittermeier, R.A.; Gil, P.R. and C.G. Mittermeier. (1997). Megadiversity: Earth's Biologically Wealthiest Nations. Conservation International, Cemex.

Riaz, M. (2013). Ecomorphological studies on some thalloid hepatics of Kishtwar (J&K). M.Phil dissertation, University of Jammu, Jammu.

Robinson, H. (1965). A small collection of Bryophytes from Kashmir. The Bryologist, 68: 313–320.

Sharma, A. and Langer, A. (2012). Liverworts of Kishtwar, J & K (India) - a preliminary survey. The Bioscan, **7**(1):0-0.

Singh, D.K. (1997). Liverworts. In: Mudgal, V. and P.K. Hajra, (eds.). Floristic diversity and conservation strategies in India I, pp: 235-300. BSI, Calcutta.

Srivastava, S.C. (1979). Hepaticae of Kashmir valley. Nova Hedwigia, 63: 333-338.

Srivastava, S.C. (1998). Distribution of Hepaticae and Anthocerotae in India. In: Chopra, R.N. (ed).

Topics in Bryology, pp: 53-85. Allied Publisher Ltd., New Delhi.

Tanwir, M. (2005). Studies on the diversity of hepatic flora of district Poonch (North-West Himalaya). Ph.D. Thesis, University of Jammu, Jammu.

Tanwir, M. and Langer, A. (2004) Marchantialean Flora of Jammu region (J&K state) - A preliminary survey. In: Kamili, A.N. and A.R. Yousuf (eds.). pp: 23-30. Bioresources: Concerns and Conservation CORD, University of Kashmir, Srinagar.

Tanwir, M. and Langer, A. (2006). Liverworts of Ladakh, J&K state (North-West Himalaya) India. Journal of Indian Botanical Society, 85:71 – 73.

Tanwir, M., Langer, A. and Bhandari, M. (2008). Liverwort and Hornwort flora of Patnitop and its Adjoining Areas (J&K), Western Himalaya, India. Geophytology, 37(1-2): 35–41.

Vanderpoorten, A. and Goffinet, B. (2009). Introduction to Bryophytes. Cambridge University Press. Cambridge, UK.

Vashistha, B.D. (1998). Distribution of Mosses in India. In: Chopra, R.N. (ed). Topics in Bryology, pp: 86-11. Allied Publisher Ltd., New Delhi.

SHARE OF IPM COMPONENTS INVOLVED IN PADDY PLANT PROTECTION AT DIFFERENT VILLAGES OF DHAMTARI DISTRICT IN CHHATTISGARH

Randeep Kr Kushwaha*[1], Vijay Kr Koshta[2], Sanjay Sharma[2] and Jaya Laximi Ganguli[2]

[1] Department of Agriculture, C.G. Govt., Raipur, Chhattisgarh, India- 492 012
[2]Department of Entomology, CoA, IGKV, Raipur, Chhattisgarh, India- 492 012
Email: rndp2010@gmail.com

Received-18.10.2015, Revised-26.10.2015

Abstract: The study was conducted at the prone area of different villages in Dhamtari district. During 2009, the average cost of IPM components involved with respect to paddy plant protection was ranged from Rs. 47.94 to 1931.21.The maximum cost of the chemical practices (Rs. 1931.21) was recorded followed by cultural practices (Rs. 2396.89) and minimum (Rs.47.94) in biological practices with the cost of share was 68.92, 20.30 and 1.71 percent, respectively. Whereas, during 2010, the Average cost of IPM components was ranged from Rs. 109.07 to 2520.92.The maximum cost of the chemical practices (Rs. 2520.92) was recorded followed by cultural practices (Rs. 769.26) and minimum (Rs.109.07) in biological practices with the cost of share was 63.28, 13.54 and 3.46 percent, respectively. Pooled cost of paddy plant protection was ranged from Rs. 109.07 to2520.92. The maximum cost of the chemical practices (Rs. 2520.92) was recorded followed by cultural practices (Rs.769.26) and minimum (Rs. 109.07) in biological practices with the cost of share was 68.85, 12.56and 2.98percent, respectively. Descending order of the average cost of different practices of IPM components can be ranked as biological practices<physical practices<cultural practices<chemical practices. On the basis of information collected from the contact farmer through personal interview, some possible reasons comes out which may be the maximum respondents use of chemical practices on paddy cultivation which causes several problems such as development of insecticide resistance, environmental pollution and undesirable effects on non-target organisms.

Keywords: Cost of paddy cultivation, Plant protection cost, Cost of IPM component, Share of IPM cost in Dhamtari district

INTRODUCTION

Rice is the main food of the largest population of the World. About 90 % rice in the world is grown and consumed by the population of the Asian countries which constitute 58 % population of the World (Chowdhury *et al.,* 2014).The pests which survived, build-up fasterbecause of either the absence of natural enemies or very low populations which were ineffective in preventing build-up of hoppers population (Kulshreshth and Kalode, 1976).The continuous use of insecticides has destroyed the natural equilibrium between *N. lugens* and its natural enemies in India. In Asia, India has the largest area under the rice accounting for 28.5 per cent of the global rice area.Singh *et al.,* (2004) they examined the pattern of pesticide use in paddy cultivation and assessed the economic and environmental impact of adaptation of IPM practices in paddy in Haryana. Partial adoption of different IPM practices results in higher net return and reduced unit cost of production have been observed under IPM practices.The study of potential IPM farmer cooperators in Laguna, Rola *et al* (1988) found that about 31% of respondents thought that all insects are enemies of rice.However, a few farmers identified spider, dragonfly, and grasshopper as naturalenemies of rice pests. Most farmers (80%) spray when they see theseinsects because they believe that the crop will be damaged. Most farmers (73.3%) spray as needed, when they feel that insects may damage their crop, but their idea ofneed was not related to any economic threshold.The cost incurred and returns realized from pesticide use were worked out to Rs 2054.30 ha^{-1} as reported byShende, N. V. and Bagde, N. T. (2013).It is observed that 31.67 per cent farmers were applied one spray of weedicide. The application of weedicides was not so common in the sample area. These farmer were applied weedicides might be due to unavailability of labour or high wage rate for weeding.Sarkar *et al.* (2013) reported that the magnitude of crop loss due to pests, disease and weed infestation in paddy is very high. The actual production with attack is varied from19.36 quintal to 20.88 quintal per acre. The overall loss with attack has been found to be 3.54 quintal per acre. Similarly, the overall normal production without attack is 23.52 quintal per acre. However, the percentage loss over normal production is less (15.05 per cent) than that of percentage loss over actual production.

MATERIAL AND METHOD

The study was conducted at the prone area of different villages in Dhamtari. The practices applied by the farmers related to the share of IPM components over the years in each of the village during *kharif*crop season. There were ten each village in the Dhamtari*(viz.,* Medka**,** Kuhkuha**,** Bharda**,** Paraswani**,** Dahdaha**,** Shivnikala**,** Ravanguna**,** BakniandTenwari**)** andJanjgir-Champadistricts **(** *viz.,* Satrelikala, Temar, Portha, Dongiya, Jetha, Mudabhata, Parsadakala, Dumarpali, DeragarghandDorkivillages)selected for the study. In each village, ten respondents were selected randomly in potential growing area during paddy cultivation in

*Corresponding Author

the year 2009 and 2010. The interview schedule was formulated on the basis of objectives framed out in "English" after thorough studies and discussion with the expert prior to conduct interviews. Interview schedule was performed with the respondents in "Hindi" through proper discussion and easy response. Tools and techniques were adopted on the personal interview in collecting data with respondents on their observations/ experiences. Respondents were interviewed through personal interview technique with the assurance that information given by them would be kept confidential without complications in the most formal and friendly atmosphere. The cost of IPM componentsdata was processing and statistical framework used to calculatedstandard method. The collected data were tabulated into the coding sheet and then appropriate statistical techniques were applied for analysis of data according to objectives as suggested by Cochran and Cox (1957).

RESULT AND DISCUSSION

The share of IPM components involved with respect to cost incurred per ha in paddy plant protection at different villages of Dhamtari district during 2009 and 2010 are presented in table- 1, 2, & 3 and fig.- 1, 2& 3.

Cultural practices

During 2009, cost of the cultural practices ranged from Rs. 411.45 to 709.57. The maximum cost of cultural practices (Rs.709.57) was noticed in village V_5 followed by village V_8 (Rs.676.00) with the minimum (Rs.411.45) in village V_4. During 2010, the cost was ranged from Rs. 327.45 to 1682.67. The maximum (Rs.1682.67) was recorded in village V_3 followed by village V_6 (Rs.1514.04) with the minimum (Rs.327.45) in village V_1. On the basis of two years, the cost of cultural practices was ranged from Rs. 368.58 to 1171.97. The maximum (Rs.1171.97) was recorded in village V_3 followed by in village V_6 (Rs.1070.98) with the minimum (Rs.368.58) in village V_1.

Physical practices

District, during 2009, cost of the physical practices ranged from Rs. 0.00 to 460.77. The maximum cost of the physical practices (Rs.460.77) was recorded in village V_9 followed by in village V_2 (Rs.390.04) with the minimum (Rs.37.10) in village V_4 while village V_1 not adopted any physical practices. During 2010, the cost was ranged from Rs. 45.55 to 652.35. The maximum (Rs.652.35) was recorded in village V_5 followed by in village V_9 (Rs.354.18) with the minimum (Rs.45.55) in village V_4. On the basis of two years, the cost was ranged from Rs. 69.05 to 867.43. The maximum (Rs.867.43) was recorded in village V_6 followed by in village V_3 (Rs.842.10) with the minimum (Rs.69.05) in village V_4.

Biological practices

During 2009, cost of the biological practices ranged from Rs. 0.00 to 147.26. The maximum cost of the biological practices (Rs.147.26) was noticed in village V_3 followed by in village V_6 (Rs.96.15) with the minimum (Rs.89.43) in village V_{10} while no costs were recorded in village V_1, V_2, V_5 andV_8, respectively. During 2010, the cost was ranged from Rs. 0.00 to 560.00. The maximum (Rs.560.00) was recorded in village V_3 followed by village V_6 (Rs.364.00) with the minimum (Rs.294.00) in village V_{10} while no costs were recorded in village V_1, V_2, V_5 andV_8, respectively. On the basis of two years, the cost was ranged from Rs. 0.00 to 353.63. The maximum (Rs.353.63) was recorded in village V_3 followed by village V_6 (Rs.230.08) with the minimum (Rs.41.36) in village V_7.

Chemical practices

During 2009, cost of the chemical practices was ranged from Rs. 1220.57 to 2649.11. The maximum cost of the chemical practices (Rs. 2649.11) was recorded in village V_5 followed by village V_8 (2396.89) with the minimum Rs.1220.57) in village V_4. During 2010, the cost was ranged from Rs. 1148.99 to 5386.85. The maximum (Rs.5386.85) was recorded in village V_6 followed by village V_3 (Rs.4806.81) with the minimum (Rs.1148.99) in village V_4.On the basis of two years, the cost was ranged from Rs. 1258.05 to 3789.18. The maximum (Rs.3789.18) was recorded in village V_6 followed by village V_9 (Rs.3436.59) with the minimum (1258.05) in village V_7.

The overall the share of IPM components involved in paddy plant protection at different villages of Dhamtari district, during 2009, the average cost of paddy plant protection was ranged from Rs. 47.94 to 1931.21.The maximum cost of the chemical practices (Rs. 1931.21) was recorded followed by cultural practices (Rs. 2396.89) and minimum (Rs.47.94) in biological practices with the cost of share was 68.92, 20.30 and 1.71 percent, respectively. Whereas,during 2010, the Average cost of IPM components was ranged from Rs. 109.07 to 2520.92.The maximum cost of the chemical practices (Rs. 2520.92) was recorded followed by cultural practices (Rs. 769.26) and minimum (Rs.109.07) in biological practices with the cost of share was 63.28, 13.54and 3.46percent, respectively.Pooled cost of paddy plant protection was ranged from Rs. 109.07 to2520.92. The maximum cost of the chemical practices (Rs. 2520.92) was recorded followed by cultural practices (Rs.769.26) and minimum (Rs. 109.07) in biological practices with the cost of share was 68.85, 12.56and 2.98percent, respectively.Prasad (1991) revealed that the hardly (23.00%) of paddy farmers used recommended varieties and more than (90.00%) of the farmers did not treat seeds before sowing. Similar type finding were reported by Mishra *et al.*, 1994 they observed that the IPM techniques and skills by

involving a varieties of methods like cultural, mechanical, biological and chemical have shown increase in rice yield in 40 ha of farmers field during 1983 to 1990 with low cost on plant protection inputs, resulting in net saving to the growers. Similar finding were reported Rajendra (2000) they conducted a study in Akola district of Maharashtra state and reported that 85.40% of farmers were medium adopters of bio control measures whereas, a mere 8.00% them of were high adopters and remaining 6.56% of them were low adopters of bio control measures. Not accurate but similar finding given Singh *et al.,* (2004). They examined the pattern of pesticide use in paddy cultivation and assessed the economic and environmental impact of adaptation of IPM practices in paddy in Haryana.

Table 1. Share of IPM components involved in paddy plant protection at different villages of Dhamtari district during 2009

Practices	Surveyed village (ha^{-1})										Av	Share (%)
	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}		
Cultural	409.70	674.08	661.26	411.45	709.57	627.91	417.83	676.55	644.69	455.97	**568.90**	**20.30**
Physical	0.00	390.04	339.20	37.10	363.78	385.85	76.79	360.26	460.77	126.10	**253.99**	**9.06**
Biological	0.00	0.00	147.26	52.42	0.00	96.15	26.72	0.00	67.46	89.43	**47.94**	**1.71**
Chemical	1635.11	2279.77	1983.77	1220.57	2649.11	2191.51	1263.16	2396.89	2231.04	1461.15	**1931.21**	**68.92**
Total	**2044.81**	**3343.89**	**3131.49**	**1721.54**	**3722.46**	**3301.42**	**1784.5**	**3433.7**	**3403.96**	**2132.65**	**2802.04**	

Table 2. Share of IPM components involved in paddy plant protection at different villages of Dhamtari district during 2010

Practices	Surveyed village (ha^{-1})										Av	Share (%)
	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}		
Cultural	327.45	962.64	1682.67	494.89	949.85	1514.04	631.30	842.81	1432.51	857.97	**969.61**	**19.72**
Physical	0.00	746.00	1345.00	101.00	659.00	1349.00	214.00	576.00	1200.00	466.00	**665.60**	**13.54**
Biological	0.00	0.00	560.00	143.00	0.00	364.00	56.00	0.00	285.00	294.00	**170.20**	**3.46**
Chemical	1579.00	4100.41	4806.81	1148.99	2809.81	5386.85	1252.93	3196.20	4642.13	2183.22	**3110.63**	**63.28**
Total	**1906.45**	**5809.05**	**8394.48**	**1887.88**	**4418.66**	**8613.89**	**2154.23**	**4615.01**	**7559.64**	**3801.19**	**4916.04**	

Table 3. Pooled cost share of IPM components involved in paddy plant protection at different villages of Dhamtari district during 2009 & 2010

Practices	Surveyed village (ha^{-1})										Av	Share (%)
	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}		
Cultural	368.58	818.36	1171.97	453.17	829.71	1070.98	524.57	759.68	1038.60	656.97	**769.26**	**21.01**
Physical	0.00	568.02	842.10	69.05	511.39	867.43	145.40	468.13	830.39	296.05	**459.79**	**12.56**
Biological	0.00	0.00	353.63	97.71	0.00	230.08	41.36	0.00	176.23	191.72	**109.07**	**2.98**
Chemical	1607.06	3190.09	3395.29	1184.78	2729.46	3789.18	1258.05	2796.55	3436.59	1822.19	**2520.92**	**68.85**
Total	**1975.64**	**4576.47**	**5762.99**	**1804.71**	**4070.56**	**5957.66**	**1969.37**	**4024.36**	**5481.80**	**2966.92**	**3859.04**	

*Cultural =summer deep Ploughting, Seed treatment;Physical =Light trap, pheromone trap;Biological =Trichocard, microplex, Chemical=Different groups of insecticides

* V_1= Medka, V_2= Kuhkuha, V_3= Bharda, V_4= Paraswani, V_5= Dahdaha, V_6= Shivnikala, V_7= Parsadakala, V_8= Ravanguna, V_9= BakniandV_{10}= Tewari

* Number of ten farmersin each village

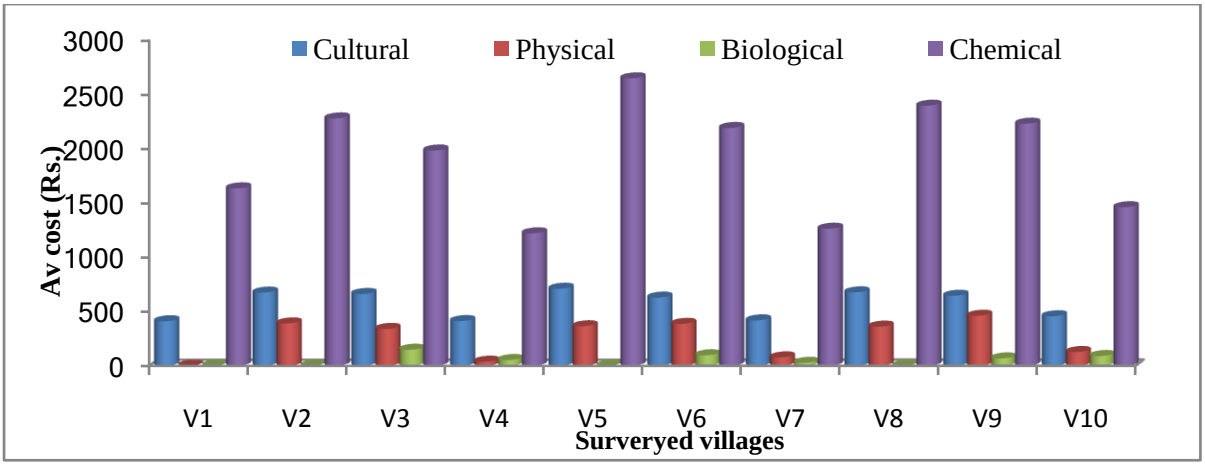

Fig 1. Share of IPM components involved in paddy plant protection at different villages of Dhamtari district during 2009

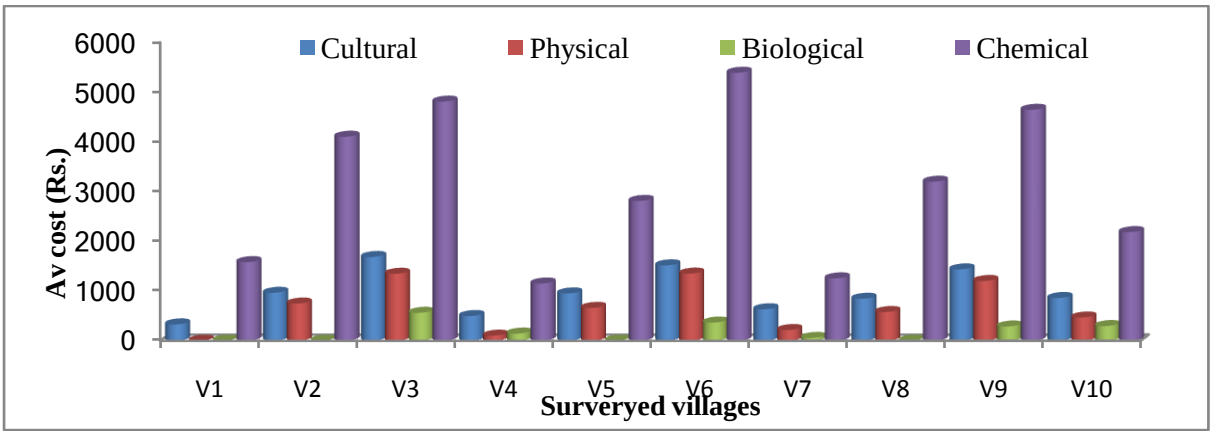

Fig. 2. Share of IPM components involved in paddy plant protection at different villages of Dhamtari district during 2010

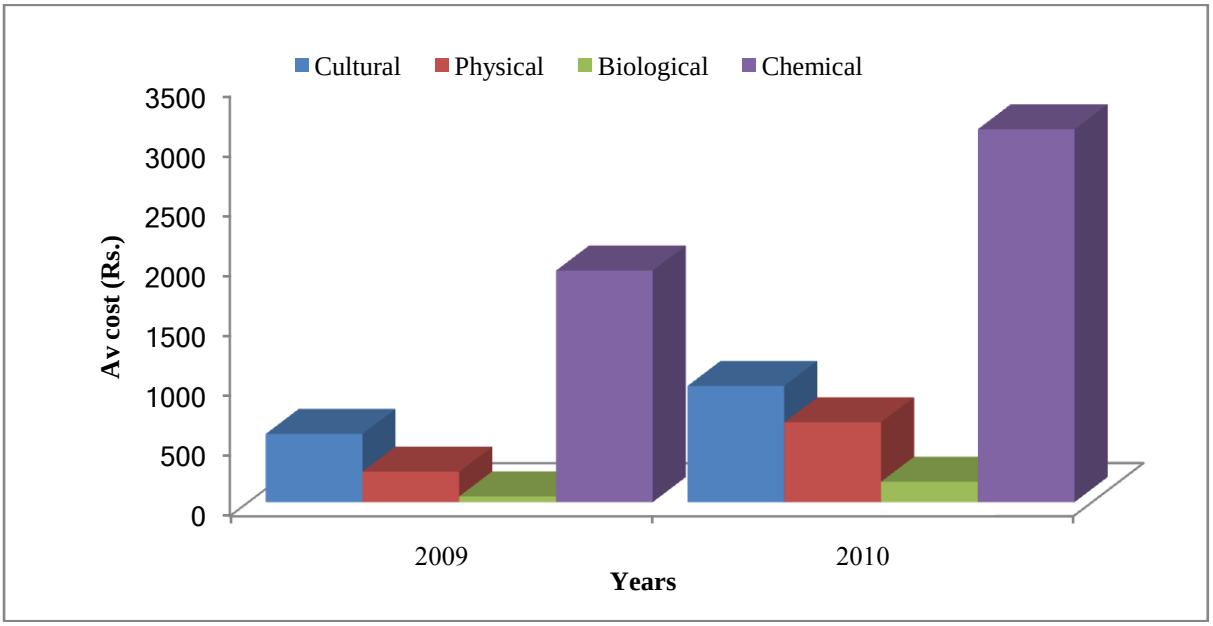

Fig. 3. Pooled cost of IPM components involved in paddy plant protection at different villages of Dhamtari district during 2009 &2010

The farmers in the study area were using more quantity of pesticide. Therefore, there is an urgent need for proper education to the farmers about the balanced use of pesticides. The farmers should be educated to identify the threshold level of pest infestation and take measures only after that instead of blindly following the neighbouring farmers while applying plant protection chemicals. The farmers may be encouraged to use not only less toxic chemicals to human and livestock but also less persistent in the environment in place of more toxic and more persistent chemicals. They also need to be advised about the cultural, physical, biological practices applying and identifying the spurious techniques and methods as possible manner.

REFERENCES

Chowdhury Md. R.; Kumar, V.; Sattar, A. and Brahmachari, K. (2014). Studies on the water use efficiency and nutrient uptake by rice under system of intensification. *The Bioscan*.**9(1):** 85-88.

Cochran, W. G. and Cox, G. M. (1957). Experimental designs. Second edition.John Willey and Sons. New York.

Kulshreshtha, J. P., and Kalode, M. B. (1976). Work done on threshold of economic injury of brown planthopper, *N. luges* and rice gall midge, *P. oryzae* in India. Paper presented at the *IRRI*, Los Baños, Philippines.

Mishra, R. P. L.; Arasumallaiah, K. R. and Diwakar, M. C. (1994). Integrated pest management approaches for rice- A case study in Karnataka. *J. of plant protection Bulletin*, **46(1):** 6-8.

Prasad, R. S. (1991). Farmers' knowledge of improved technology practices of paddy and ragi. *Current Research* **20 (8):** 118-119.

Rajendra, C. (2000). Knowledge and adoption of farmers about biocontrol management.*Maharashtra Journal ofExtension Education*, **19:** 41-47.

Rola, A. C.;Chupungco, A. R.;Adalla, C. B.;Hoque, M. M.; Stuart, T.H. and Sumayao, B. R. (1988). Resultsof the benchmark survey.Integrated Pest Management Extension and Women Project.LosBaños, Laguna, Philippines.

Sarkar, D.; Datta, V. and Chattopadhyay, K. S. (2013). Assessment of Pre and Post- Harvest Losses in Rice and Wheat in West Bengal, *AERC*, Visva-BharatiSantiniketan, 2013, p-6.

Shende, N. V. and Bagde, N. T. (2013). Economic consequences of pesticides use in paddy cultivation.*J. of AIJRHASS*, 4 (1), Sept-Nov, 2013, pp 25-33.

Singh, A.; Ranjit, K.; Das, D. K. and Jain, P. K. (2004). Economic and environmental impact of integrated pest management in paddy: A case study of Haryana, *Agril. Economics Research Review*, 17: 69-84.

EFFECT OF MOISTURE CONTENT ON SOUND ABSORPTION CO-EFFICIENT OF SOME INDIAN TIMBERS

D. Biswal[1] and *S. Rout[2]

[1]Forest Research Institute (Deemed) University, Deradhun- 248006 (Uttarakhand) INDIA.
[2]School of Forestry & Environment, Sam Higginbottom Institute of Agriculture Technology & Sciences, Allahabad-211007 (Uttar Pradesh) INDIA.
Email: srout.forestry@gmail.com

Received-17.10.2015, Revised-26.10.2015

Abstract: Wood and wood-base materials frequently are used as interior finish in buildings where sound absorption (reduction of the level of sound generated in a room, within that room) needs to be estimated to compare the effectiveness of different species. Various wood based materials of three Indian timbers *(Dalbergia sissoo, Cedrus deodara* and *Populus deltoids)* were evaluated for acoustical absorption using the Bureau of Indian Standard (I.S: 10420 -1982) impedance tube method to determine the effect of moisture content based on their specific gravity on sound absorption. Absorption produced by different species at 25 and 35 percent moisture content at room temperature was affected. *Cedrus deodara* species shown best value for sound absorption coefficient at the frequency level of 1000 hertz while the *Populus deltoids* shown minimum values of sound absorption coefficient.

Keywords: Absorption, *Cedrus deodara*, Specific gravity

INTRODUCTION

Wood is a biologically renewable substance and a most fascinating material because of its very complex structure and variety of uses. Wood is defined as "the hard, fibrous tissue that comprises the major part of stems, branches and roots of trees." Wood can be considered as a biological composite that is produced by the living organisms of trees. The wood which is having submicroscopic components, are held together by specific interaction, assuring the high performance of the tree, without it suffering from debilitating damage in difficult environments (i.e. wind, snow, rain, etc.). The complex assemblies reveal a hierarchical organization of the structure. Before addressing the coexisting aspects of wood acoustics, let us consider the hierarchical structure of wood at the macroscopic level, in order to provide background to our understanding of the behavior of wood. Cremer and Muller (1982) demonstrated that it is possible to accomplish some predetermined acoustical design objectives by selecting the enclosure surfaces to absorb, reflect or transmit the incident wave. How well this objective is accomplished will depend upon the designer's knowledge and skill in the selection and use of materials. Similar statements have been advanced by all acousticians involved in architectural acoustics (Beranek, 1962; Egan, 1988). The acoustic efficiency of walls constructed with wood depends on the method of installation and on the basic properties of the material. A deeper understanding of the very complex phenomena related to the sound insulation of walls needs to consider the sound absorption of different wood species (Kollmann and Cote, 1968). Wood was and still is a basic building material. A wide range of structural applications of wooden members in foundations, light frame construction, beams and columns, bridges, etc. (Freas, 1989). Keeping in view of the importance the study was aimed to determine sound absorption coefficient of timbers at two moisture levels.

MATERIAL AND METHOD

Description of experimental setup:
Sound absorption coefficient of the all 12 samples at two different moisture content levels was determined with the help of standing wave method or tube method according to Bureau of Indian Standard IS:10420 -1982. It includes arrangement of different apparatus such as impedance tube, sinusoidal plane wave source, probe tube, output indicator and specimen. Description in detail given below:

Figure 1. Experimental setup.

*Corresponding Author

Impedence Tube

It consists of a long tube of fixed length and uniform cross section with rigid walls which absorb negligible sound energy and is vibration free. The one end of tube a source of sinusoidal plane wave is kept and on the other end the specimen mounted. The minimum length of the tube in meters and maximum diameter in cm shall be given below:

$$l_{Min} = \frac{300}{f_{Min}}$$

$$d_{Max} = \frac{2000}{f_{Max}}$$

Where, l_{Min} = Minimum length

d_{Max} = Maximum diameter

f_{Min} = Lowest frequency

f_{Max} = Highest frequency

Sinusoidal plane wave source

It is an audio signal generation used to excite a loud speaker in order to produce the sinusoidal plane waves.

Probe tube

It is a movable microphone fixed at the end of the probe tube on the axis of the impedance tube is use for exposing the standing wave pattern. The probe tube including support from inside the tube have cross sectional area of not greater than 5% of the cross sectional area of impedence tube and the wall thickness of the probe tube shall be not less than 1/8 of the outside diameter of the impedance tube.

Output indicator

It represents a cathode ray oscilloscope on suitable volt meter connected through an audio amplifier is used as output indicator.

Preparation of specimen

In the first stage test specimens of 15 mm thickness and disc of side diameter 50 mm more than the diameter of tube and free from defects such as cracks, splits, loose, decayed knots were prepared from the plank of each species taken for present study. Then these specimens were sanded manually to make smooth surface with the help of a sand paper of 40, 100. The specimens were conditioned at room temperature to get constant weight.

Figure 2. Samples of three different species.

Test Procedure

The specimen was mounted in the specimen holder in such a way that the grain directions being vertical with a rigid backing. The backing was made up of solid steel / brass plate which have a minimum thickness of 10 cm. The backing was provided with flying not screws to anchor it rigidity in the desired position. The fixing was so tight due to which there was no air transmission to outside the tube. The sinusoidal plane waves of known frequency transmitted longitudinally along the tube.

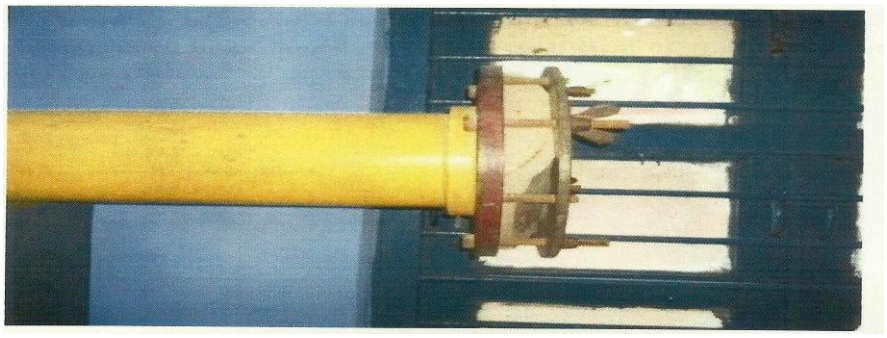

Figure 3. The specimens were mounted in specimen holder.

Waves of reduced amplitude reflected by the specimen, these were combined with the incident wave in order to form a standing wave pattern along the tube. The pattern was expand by the tube whose output was reflected on the output indicator due to which we get the relative and maximum pressure amplitude in the standing wave pattern and that was recorded. The stationary wave pattern was produced at the following test frequencies such as 250 hertz, 500 hertz and 2000 hertz. Sound absorption coefficient of sample was determined based on the formula given below:

$$\sigma = 1 - \frac{(M - N)^2}{(M - N)^2}$$

Where,

σ = Sound absorption coefficient
M = Maximum pressure amplitude
N = Minimum pressure amplitude

Sound absorption coefficient of all the test specimen taken from the three wood species viz. *Dalbergia sissoo, Cedrus deodara and Populus de!toides* was determined by the same procedure as described above at different two moisture content percent.

Determination of specific gravity and moisture content of timber

The relative density of a material is also known as specific gravity, it is defined as the ratio of the weight of material to the weight of an equal volume of water at 4 degree Celsius. In order to calculate the specific gravity, weight of a wood sample was recorded with the help of electronic balance as initial weight and dimensions of sample (length, width and height) was measured with the help of veneer caliper to calculate the volume of the sample. After that this specimen was kept in an oven for 24 hours at a temperature of 103 °C or till it gets constant weight. The weight of the specimen was recorded.

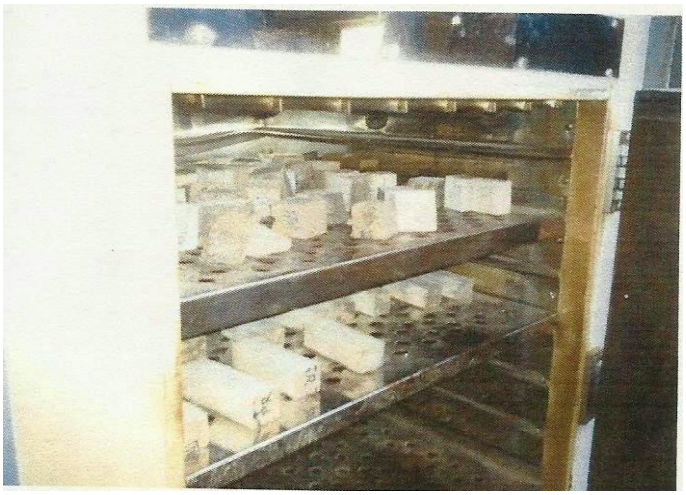

Figure 4. Samples in the electric oven.

The specific gravity of the sample was worked out based on the formula given below:

$$\mathbf{S = W_0 / V_s}$$

Where,

S = Specific gravity
W_0 = Oven dry weight of sample (grams)
V_S = Volume of sample in green condition (cm^3)

Moisture content % of each sample was calculated base on the formula given below:

M.C. % = (G.W. – O.D.W) / O.D.W * 100

Where,

M.C. = Moisture Content (%)
G.W. = Green weight of moisture strips (gm)
O.D.W = Oven dried weight of moisture strips (gm)

Specific gravity and moisture content of all the wood samples of *Dalbergia sisso, Cedrus deodara* and *Poplar deltoids* was determined by the similar test procedure described above.

RESULT AND DISCUSSION

The result obtained during the present course of investigation was carried out to visualize significant influence moisture content on Sound Absorption Co-efficient of Some Indian timbers. Data recorded on specific gravity, moisture content and sound absorption coefficient determined at four different frequencies viz 250Hz, 500 Hz, 1000 Hz and 2000 Hz for individual specimens of wood species viz. *Dalbergia sissoo, Cedrus deodara* and *Populus deltoids* are reflected in the table 1 and average values are also presented in the Table 2. The data reveals that specific gravity was found maximum for *Dalbergia sissoo* (0.683) and minimum for *Populus deltoids* (0.459). The data also indicate that the values of sound absorption coefficient determined at four frequencies at moisture content level viz. 20.1 % are lower than the value found at moisture content 32.3% for *Dalbergia sissoo*. Similar type values of sound absorption coefficient are also found for *Cedrus deodara* at 19.0 % & 34.8% and 14.0% & 30.7% for *Populus deltoids* moisture content levels (Table 1 and 2). If we focus on the values of sound absorption coefficient of three given species then we found that there is a continuous increase in these values at different ranges of frequency from 250 – 1000 Hz for *Cedrus deodara* but *Dalbergia sissoo* and *Populus deltoids* do not show similar trend was also found by Hui *et al.* (2004) in case of Eucalypt species. The value of sound absorption coefficient at 2000Hz is found to decline in comparison to the value at 1000 Hz for each wood species. It means sound absorption coefficient has no clear trend with frequencies.

Table 1. Individual value of moisture content and sound absorption coefficient of three different species.

Species	**Sample No**	**Moisture Content (%)**	**Sound absorption coeff. (σ)**			
Frequency (Hz)	→		250	500	1000	2000
Populus deltoides	A_1	13.16	0.776	0.692	0.776	0.438
		30.25	0.711	0.640	0.726	0.396
	A_2	14.05	0.703	0.750	0.853	0.750
		30.72	0.622	0.692	0.720	0.596
	A_3	14.47	0.692	0.653	0.750	0.490
		30.88	0.596	0.653	0.750	0.396
	A_4	14.42	0.750	0.674	0.783	0.692
		30.82	0.532	0.556	0.674	0.640
Cedrus deodara	B_1	18.58	0.582	0.674	0.809	0.665
		33.09	0.472	0.750	0.817	0.582
	B_2	20.08	0.532	0.730	0.817	0.582
		35.84	0.396	0.674	0.779	0.438
	B_3	18.48	0.582	0.726	0.840	0.582
		35.45	0.510	0.692	0.794	0.463
	B_4	19.08	0.556	0.716	0.840	0.610
		34.64	0.423	0.571	0.766	0.610
Dalbergia sissoo	C_1	19.88	0.776	0.720	0.711	0.575
		32.09	0.582	0.640	0.720	0.604
	C_2	18.19	0.703	0.654	0.750	0.640
		31.67	0.617	0.684	0.674	0.556
	C_3	20.50	0.726	0.674	0.750	0.660
		32.47	0.665	0.674	0.711	0.472
	C_4	21.84	0.750	0.700	0.783	0.575
		33.11	0.640	0.622	0.692	0.538

Table 2. Average value of specific gravity, moisture content and sound absorption coefficient of three different species.

Species	Specific Gravity (O.D. wt / Vol. green)	Moisture Content (%)	Sound absorption coeff. (σ)			
Frequency (Hz)	→		250	500	1000	2000
Populus deltoides	0.459	14.0	0.615	0.635	0.717	0.506
		30.7	0.730	0.692	0.790	0.592
Cedrus deodara	0.556	19.0	0.450	0.671	0.788	0.523
		34.8	0.562	0.711	0.826	0.610
Dalbergia sissoo	0.683	20.1	0.626	0.655	0.699	0.542
		32.3	0.738	0.687	0.748	0.612

Comparison of sound absorption coefficient values of three different species at different frequency levels in both green as well as dry condition were one in order to determine which species shows minimum and maximum values of sound absorption coefficient. For this purpose graphical analysis of these species one separately an found that average values of sound absorption coefficient of is relatively more in green condition as compared to the dry condition in timber species at different level of frequencies

CONCLUSION

Three species were analyzed on the basis of their specific gravity in order to determine the effect of moisture content on sound absorption coefficient. It was revealed that the sound absorption coefficient is always more at higher moisture content level than lower moisture content level in timbers taken for the present study. It is also observed that the value of sound absorption coefficient at four different levels of frequencies were varies from 0.44 to 0.78. *Cedrus deodara* species shown best value for sound absorption coefficient at the frequency level of 1000hertz while the *Populus deltoides* shown minimum values of sound absorption coefficient.

REFERENCES

Bernaek, L. (1962). Music, Acoustics and architectures. Wiley. New York.

Cremer, L.and Muller, H.A. (1982). Principles an application of room acouistics, volume ½. Applied science. London.

Egan, D. (1988). Architectural Acoustics. Mc Grawhill. New York.

Freas, A.D. (1989). Building with wood In: Schniewind AP (ed) Concise encyclopedia of wood and wood based materials. Pergamon Press. Oxford. pp 31-37.

Hui, J.Z.,Zhao,J.R. and Hua,B.F.(2004).Sound absorption property of wood for five Eucalypts species. Journal of Forestry Research. **15**(3):207-210.

Kollman, F.F.P. and Cote, W.A. (1968). Principles of wood science and technology. Springer, Berlin Heidelberg. New York.

CROP WEATHER RELATIONSHIP OF SOYBEAN VARIETIES UNDER DIFFERENT DATES OF SOWING IN CHHATTISGARH PLAIN ZONE

Deepanshu Mukherjee*, R. Singh, R. Lakpale and J.L. Chaudhary

College of Agriculture, IGKV, Raipur (C.G.) 492012

Received-12.10.2015, Revised-20.10.2015

Abstract: Soybean (*Glycine max* (L) Merril.) is one of the leguminous oilseed crops in tropical and sub-tropical regions of India and is one of the classical short day plants and most of its genotypes respond as quantitative short day plant. Soybean varieties "JS-93-05", JS-9752, and JS-335 were grown as a test crop and recommended dose of nitrogen, phosphorus and potassium *i.e.,* 20:60:40 kg ha-1, respectively. The crop was shown on 10 June, 20 June and 30 June 2014 after the onset of monsoon maintaining spacing of 30 cmX10 cm using a certified seed rate of 75 kg ha-1. At 25 DAS, significantly higher dry matter observed under D1 (10 June) which was found at par to D3 (30 June). Maximum crop growth rate was found in 10 June and the lowest crop growth rate was observed in 20 June. Highest accumulated growing degree day, Accumulated Photo thermal units (PTU), Accumulated Helio thermal units (HTU) and heat use efficiency was observed under 10th June sown variety JS-9752 at maturity stage (2057.2) and the lowest GDD recorded with variety JS- 335 under D3 (30 June) (1615.8).

Keyword: Soybean varieties, Oil seed crops, Weather

INTRODUCTION

Soybean (*Glycine max* (L) Merril.) is one of the leguminous oilseed crops in tropical and sub-tropical regions of India. It is a short duration and thermosensitive crop and its response to yield varies with variety and temperature. This crop is successfully grown in *Kharif* as well as in rabbi/summer, where adequate irrigation facilities are available. India has made impressive progress in agriculture during the last three decades, culminating in self-sufficiency in cereals and made good efforts in increasing the production and productivity of pulses and oilseeds crops. Soybean (*Glycine max* L.) ranks first amongst oilseed crops in the world and is also known as the wonder crop of the twentieth century. It contributes nearly 25 per cent of the world's total oil and fat production. Soybean is a World's first rank crop as a source of vegetable oil and the cheapest source of vegetable oil and protein having 40 per cent protein well balanced in essential amino acids, 20 per cent oil rich with poly unsaturated fatty acids specially Omega 6 and Omega 3 fatty acids, 6 to 7 per cent total mineral and 5-6 per cent crude fibre (Chauhan *et al.,* 1988). The protein quality of soybean is equivalent to that of meat, milk products and eggs. It is generally grown as a rainy season crop under rainfed situation predominantly in *Vertisols* and associated soils. In India, soybean occupies an area of 12.2 m ha with production potential of 11.95 million tonnes and average productivity of 979.3 kg ha-1 (Anonymous, 2013a). The productivity of soybean is less in India as compared to world average (2484.1 kg ha-1). Global area and production of soybean is 111.27 m ha and 276.4 million tonnes respectively (Anonymous, 2013b). The major soybean producing states in India are Madhya Pradesh, Maharashtra, Rajasthan, Andhra Pradesh and Karnataka (Anonymous, 2013). In Chhattisgarh, agriculture is mainly based on rain water, therefore most of the crops are grown as rainfed in *kharif* season. Soybean occupies 159.59 thousand ha area with a yield of 1150 kg ha-1 (Anonymous, 2015) growing in districts like Rajnandgaon, Durg, Mungeli, Bemetara and Kabirdham. Optimum temperature for germination of soybean is approximately 30^{o}C with base temperature of 10^{o}C (Ghadekar, 2001). Soybean is one of the classical short day plants and most of its genotypes respond as quantitative short day plant. The variation of photo period sensitivity among soybean genotypes allows the crop to grow successfully across a wide range of latitudes. Photo period influences the rate of development during pre and post flowering stages. Changes, in photoperiod and temperature are reported to alter the happening of growth stages, the growth and partitioning of dry matter of this photoperiod and thermosensitive short day C3 crop (Lawn, 1989).

MATERIAL AND METHOD

The field experiment was carried out in FRBD with three replications at Research and Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur situated in Eastern Central part of Chhattisgarh at latitude of 21^{0}16' N, longitude 81^{0}36' E and altitude 289.5 m above mean sea level. The general climatic condition of Raipur is classified as sub humid with mean annual rainfall of about 1175 mm out of which 87 per cent (1023.0 mm) received during monsoon (June to September). During *Rabi*, (December to

*Corresponding Author

February) only 33.8 mm of rainfall is received and hence, rice is mostly grown under rainfed conditions. Maximum and minimum temperatures range between 24.4^{0}C and 42.6^{0}C and 10.0^{0}C and 27.5^{0}C (1 SMW and 22 SMW). Atmospheric humidity is normally higher during June to September and thereafter, decreases during *Rabi* with increased sunshine hours. Atmospheric humidity is normally higher during June to September and thereafter, decreases during *Rabi* with increased sunshine hours. The soil of the experimental field was silty clay loam in texture, neutral in reaction (pH 6.9), low in available N (242 kg/ha), medium in available P (13.6kg/ha) and high in K (250 kg/ha) (Subbiah and Asija, 1956; Jackson, 1967; Olsen *et al*., 1954 and Black, 1965.). Soybean varieties JS-93-05, JS-97 52, and JS-335, JS-97-52 and JS-335 were grown as a test crop. Recommended dose of nitrogen, phosphorus and potassium *i.e.*, 20:60:40 kg ha-1, respectively were applied through urea, single super phosphate and muriate of potash as basal in rows and fertilizer were drilled in furrow. The crop was shown on 10 June, 20 June and 30 June 2014 after the onset of monsoon. The row and plant spacing was 30 cm X 10 cm using a certified seed rate of 75 kg ha-1. Plant height at an interval of 15 days after sowing (DAS) and dry matter accumulation plant^{-1} at 15 days after sowing (DAS) up to harvest. Number of pods plant^{-1}, Number of seeds pod^{-1}, Test weight (100-seed weight), Seed yield (kg ha^{-1}), Stover yield (kg ha^{-1}) , Leaf area and leaf area index (LAI) (Tandaleand Ubale, 2007), Crop growth rate (g plant -1 day-1), Relative growth rate (g plant^{-1} day^{-1}) (Leopold and Kridemann, 1975), Heat units like Growing degree days, Photothermal Unit (PTU), Heliothermal Unit (HTU), Heat Use Efficiency (HUE), Radiation Use Efficiency (RUE), statistical analysis as per the procedure laid down by Panse and Sukhatme, (1967).

RESULT AND DISCUSSION

Dry matter accumulation and LAI

Dry matter accumulation of soybean was observed at 25, 65 and 95 DAS and the same was presented in Table 1. In general, dry matter accumulation increased throughout the crop growth period. At 25 DAS, significantly higher dry matter observed under D1 (10 June) which was found at par to D3 (30 June) and minimum dry matter accumulation observed under treatment D2 (20 June) as compared to other dates of sowing. As regard to varieties, significantly the maximum dry matter accumulation observed under V3 (JS- 335), however, it was found comparable to V1 (JS- 9752). At 35 DAS, dry matter accumulation of soybean was found unaffected due to date of sowing and as regard to varieties, maximum dry matter accumulation observed in variety V1(JS- 9752), however, it was found comparable to variety V3 (JS- 335). At 50 DAS, significantly maximum dry matter observed under D1 (10 June) which was found at par to D2 (20 June) with minimum dry matter accumulation under treatment D3 (30 June) and same trend was observed leaf area index (Kumar *et al.*,2008a). The varieties JS-9752 yielded maximum under D1 (10 June)

Crop growth rate (g plant-1 day-1)

The data presented in Table 1 showed crop growth rate of different varieties and the values of crop growth rate were fluctuating during different stages. At 25 DAS, significantly maximum crop growth rate was found in 10 June and the lowest crop growth rate was observed in 20 June. At 20-35 DAS, crop growth rate was significantly highest in 20 June and the lowest found in 10 June. At 35-50 DAS, crop growth rate is highest in 10 June and lowest found in 30 June. At 50-65 DAS, the result was found non-significant. At 65-80 DAS, crop growth rate was significantly higher in 20 June and lowest value found in 30 June. At 80- 95 DAS, the crop growth rate was maximum in 10 June which is comparable with 30 June and the lowest value was found in 20 June. Among the different varieties at 0-25 DAS, the highest crop growth rate was found in V3- JS 335 which was found comparable with V1- JS 9752 and the lowest value was found in V2- JS 9305. The same trend was also found in 20-35 DAS. At 35-50 DAS, the highest crop growth rate was found in V1 (JS 9752) which was significantly superior over V2 (JS 9305) and V3 (JS 335). At 50-65 DAS, 65-80 DAS and 80-95 DAS, the crop growth rate was found non-significant.

Relative growth rate (g plant-1 day-1)

The values of relative growth rate were higher for the varieties sowing on 10th June as compared to the crop sown on 20th June and 30th June Table 1. In 10 June the relative growth rate was highest up to 0-25 DAS, then after decrease in 50-65 DAS and it was slightly decreased in 80-95 DAS and then after RGR value was found negligible in remaining all period of observation. In 20th June the crop growth rate was showed fluctuated during in different growth stages the RGR was maximum in between 50-65 DAS and similar trend also found in 30th June. Among the different varieties, maximum relative growth rate was found during 0-25 DAS under the variety V1 (JS-9752) and lowest found in V2 (JS-9305). The similar trend also found in rest of the period then after the relative growth rate was no significant differences.

Yield attributes and yield

Pods plant^{-1}, Seed Pod^{-1} and test weight were observed at harvest of crop and the same is presented in Table 2. Significantly maximum pods plant^{-1} was observed under D1 (10th June) which was found at par to D2 (20 June) as compared to other sowing date. As regard to varieties, significantly higher seed pod^{-1} observed under V1 (JS-9752) followed by V2

(JS-9305) and V3 (JS- 335). Higher test weight of soybean seed was recorded under JS-9752 (9.97g) as compared to the test weight of JS-9305 (9.76g) whereas, JS-335 (8.94g) recorded inferior test weight among all the varieties. Among the different sowing dates significantly higher test weight was found under 10th June sowing (9.93g) and was found comparable over 20th June sowing (9.44g) and both were superior over 30th June sowing (9.28g). Similar results were obtained by Ahmad *et al.* (2010). Number of seed per pod is an objective which is depended on genotype and it is independent of environmental factors by Yari *et al.* (2013). Similar results were also obtained by Deokar *et al.* (2009). Zargar *et al.* (2011) who concluded that delayed planting dates can accelerate flowering, shorten vegetative and reproductive growth, reduce grain yield and oil content of soybean (Sadeghi *et al.*, 2013). Also in other studies, the planting delay decreased the yield. Interaction effect of date of sowing and varieties revealed that varieties JS-9752 yielded maximum under D1 (10 June), however it was found comparable with D2 (20 June) and JS-9305 with D1 (10 June) and D2 (20 June). Significantly minimum seed yield obtained with variety JS-335 under D3 (30 June) (Table 2). Higher seed yield of soybean with the crop sown up to 10 June were also reported by Jasani *et al.* (1993), Singh *et al.* (2007) and Kumar *et al.* (2008b), Yari *et al.*, (2013a) reported that planting date is one of the most effective non-economic factors on the optimal operation of the plant cultivated. Due to the short duration of grain effecting period, seed reserve amount is also reduced, which will result in reduced 1000 seed temperatures during the days can also lead to the decrease of reserve and as result, in the cases mentioned above are reason for the reduced ultimately seed yield. Yari *et al.*, (2013b) reported that seems to be due to a delay in planting date because reduced. V1 (JS 9752) varieties planted on 10 May that was able to grow very well and be able to have more grain number and had grain with weight more than those with other cultivars that may increase the yield of the cultivars in this variety V1 (JS-9752) (Baisakh and Dash, 1992). Significantly maximum stover yield (kg ha^{-1}) observed under D1 (10 June) which was found at par to D2 (20 June) and minimum under treatment D3 (30 June) as compared to other date of sowing. As regard to varieties, significantly maximum stover yield (kg ha^{-1}) observed under V1 (JS-9752). However, it was found comparable to V2 (JS-9305) and minimum stover yield (kg ha-1) observed under treatment V3-(JS- 335). Harvest Index was found significantly differed as in yield and yield attributing characters.

Effects of heat units

Accumulated Growing degree days (GDD)

Different soybean varieties responded differently in terms of accumulated GDD at the time of maturity. Highest accumulated growing degree day was observed under 10th June sown variety JS-9752 at maturity stage (2057.2) and the lowest GDD recorded with variety JS- 335 under D3 (30 June) (1615.8). In case of JS- 9752 highest accumulated growing degree day was noticed under 10th June sowing (2057.2) followed by 20th June sowing (1726.3) and 30th June sowing (1652.5). Similarly in JS-9305 higher accumulated growing degree day was observed at maturity under 10th June sowing (1982) followed by 20th June (1652.5) and 30th June sowing (1615.8). Among the variety (JS-335) was found that the highest accumulated growing degree day under 10th June sowing (1928.1) followed by 20th June sowing (1615.8). In general, the accumulated growing degree day values decreased when the sowing was delayed from 10th June, due to early maturity of crops under delayed sowing condition because of higher temperature at maturity. These results are in general agreement with the findings of Kumar *et al.* (2008b). Almost same trend was observed at different stages of observations i.e. emergence, 50% flowering, 100% flowering and pod formation.

Accumulated Photo thermal units (PTU)

Different varieties responded differently in terms of accumulated photo thermal units at the time of maturity. Highest accumulated photo thermal unit was observed under 10th June sowing of all varieties Table 3. The highest accumulated photo thermal unit value was observed by JS-9752 under 10th June sowing (26566) followed by 20th June sowing (22258) and 30th June sowing (21147). Among the variety, by JS- 9305 maximum accumulated photo thermal unit was observed under 10th June sowing (25641) followed by 20th June sowing (21351) and 30th June sowing (21133). Similarly accumulated photo thermal unit value was observed by JS- 335 under 10th June sowing (24978) followed by 20th June sowing (21823) then 30th June sowing (21133). It can be interpreted that from different sowing dates that higher PTU values were recorded with the crop sown on 10th June which decreased gradually with a delay in sowing (Sharma *et al.*, 1991).

Accumulated Helio thermal units (HTU)

The data pertaining to accumulated helio thermal unit due to different dates of sowing varieties of soybean are presented in Table 3. Helio thermal unit (HTU) of soybean varieties under different sowing dates varied considerably at maturity variety JS-9752 recorded that highest accumulated helio thermal unit observed under 10th June sowing (16978.3) followed by 20th June sowing (14373.2) then 30th June sowing (13774.6) similar result obtained by Barik and Sahoo (1989). Among the varieties JS- 9305 observed highest accumulated helio thermal unit

under 10th June (16250), followed by 20th June sowing (13866.9) and 30th June sowing (13794.3) at maturity. Similarly the variety (JS-335) observed maximum accumulated helio thermal unit under 10th June sowing (15942.7), followed by 20th June sowing (14135.7), then 30th June sowing (13794.3) at maturity (Ramesh and Gopalaswamy, 1992)

Heat use efficiency (g m-2 day-1)

Heat use efficiency (HUE) for three soybean varieties under different dates of sowing are presented in Table 4.13. Higher heat use efficiency was observed that is variety JS-9752 under 10th June sowing (0.19g m-2 day-1) closely followed by 20th June sowing (0.14g m-2 day-1) followed by 30th June sowing (0.10g m-2 day-1). Similarly JS- 9305 variety recovered maximum heat unit efficiency observed in 10th June sowing (0.15g m-2 day-1) followed by 20th June (0.14g m-2 day-1) and 30th June sowing (0.09g m-2 day-1). Variety JS-335 recovered maximum heat unit efficiency was found for 10th June sowing (0.17g m-2 day-1) followed by 20th June sowing (0.15g m-2 day-1) and 30th June sowing (0.10g m-2day-1). Maximum heat unit efficiency was found with variety JS- 9752 for D1-10th June (0.19g m-2 day-1). Similar results were also reported by Singh *et al.* (2007).

Radiation use efficiency (g MJ-1)

Radiation use efficiency (RUE) of different soybean genotypes under different dates of sowing varied considerably and was shown in Table 3. The data revealed that (JS- 9752) exhibited higher radiation use efficiency under 10th June sowing (0.87gMJ-1) followed by 20th June sowing (0.73 gMJ-1) and 30th June sowing (0.56 gMJ-1). Similarly among the varieties JS-9305 recovered the highest radiation use efficiency which has been observed in 10th June sowing (0.69 gMJ-1) followed by 20th June (0.69 gMJ-1) and 30th June (0.51 gMJ-1). Among the genotypes JS- 335 gave maximum radiation use efficiency which was found in 10th June sowing (0.76 gMJ-1), followed by 20th June sowing (0.75 gMJ-1) and 30th June sowing (0.54 gMJ-1). Highest radiation use efficiency was observed under 10th June sowing by all the varieties. Higher radiation use efficiency in 10th June sowing might be due to better conversion of light in to dry matter, better yield component and harvest index in 10th June. Similar results were reported by Singh *et al.* (2007) and Kumar *et al.* (2008b). The RUE value decreased due to delay in sowing (Kumar, 2008). Similar results have been recorded to Souza *et al.* (2009). The duration for emergence, 50 per cent flowering, 100 per cent flowering, pod formation and physiological maturity of three soybean varieties was investigated and different Dates of sowings.

Table 1. Dry matter accumulation (g plant -1) of soybean varieties at different interval under different sowing dates

Treatments	Dry matter accumulation (g plant -1)			Leaf area Index			Crop Growth Rate (g plant -1 day -1)			Relative Growth Rate (g plant -1 day -1)		
	25 DAS	65 DAS	95 DAS	25 DAS	65 DAS	95 DAS	0-25 DAS	50-65 DAS	80-95 DAS	0-25 DAS	50-65 DAS	80-95 DAS
Date of sowing												
D1 – 10 June	2.58	7.21	9.55	0.275	0.774	0.554	0.129	0.067	0.078	0.020	0.004	0.004
D2 – 20 June	2.00	5.91	8.85	0.291	0.758	0.555	0.100	0.049	0.047	0.015	0.004	0.002
D3 – 30 June	2.04	5.18	6.58	0.295	0.541	0.528	0.102	0.040	0.061	0.015	0.004	0.004
SEm±	**0.062**	**0.121**	**0.088**	**0.012**	**0.010**	**0.015**	**0.003**	**0.010**	**0.008**	**0.001**	**0.001**	**0.000**
CD(P=0.05)	**0.186**	**0.361**	**0.264**	**0.035**	**0.031**	**NS**	**0.009**	**NS**	**0.023**	**0.002**	**NS**	**0.001**
Varieties												
V1 – JS – 9752	2.28	6.75	8.87	0.26	0.70	0.55	0.11	0.04	0.05	0.02	0.02	0.00
V2 – JS – 9305	1.96	5.51	7.74	0.32	0.67	0.53	0.10	0.05	0.06	0.01	0.01	0
V3 – JS – 335	2.38	6.05	8.39	0.29	0.70	0.55	0.12	0.06	0.07	0.02	0	0.01
SEm±	**0.062**	**0.121**	**0.088**	**0.012**	**0.010**	**0.015**	**0.003**	**0.010**	**0.008**	**0.001**	**0.001**	**0.000**
CD(P=0.05)	**0.186**	**0.361**	**0.264**	**0.035**	**NS**	**NS**	**0.009**	**NS**	**NS**	**0.002**	**NS**	**NS**

Table 2. Yield and yield attributes of soybean varieties as influenced under different sowing dates

Treatments	Yield attributes of soybean			Yield of soybean		
	Pods plant -1 (no.)	Seed pod -1 (no.)	Test weight (g)	Seed yield (kg ha -1)	Stover yield (kg ha -1)	Harvest Index (%)
Date of sowing						
D1 – 10 June	74.22	2.67	9.93	2079	2655	43.96
D2 – 20 June	49.97	2.47	9.44	2019	2580	43.93

D3 – 30 June	39.97	2.22	9.28	1451	1848	44.01
SEm±	**1.050**	**0.030**	**0.319**	**69.99**	**90.29**	**0.034**
CD(P=0.05)	**3.149**	**0.089**	**NS**	**209.8**	**270.70**	**NS**
Varieties						
V1 – JS – 9752	79.09	2.72	9.97	2204	2826	43.82
V2 – JS – 9305	52.13	2.47	9.76	2139	2729	43.95
V3 – JS – 335	32.96	2.22	8.94	1209	1528	44.15
SEm±	**1.050**	**0.030**	**0.319**	**69.99**	**90.29**	**0.037**
CD(P=0.05)	**3.149**	**0.089**	**NS**	**209.8**	**270.70**	**0.101**

Table 3. Accumulated Photo thermal Units (PTU) and Accumulated Helio thermal Units (HTU) at different growth stages of soybean varieties under different sowing dates

Treatments	Accumulated Photo thermal Units (PTU)					Accumulated Helio thermal Units (HTU)				
	Emergence	50 % flowering	100 % flowering	Pod formation	Physiological maturity	Emergence	50 % flowering	100 % flowering	Pod formation	Physiological maturity
V1 – JS - 9752										
D1 – 10 June	1389	14454	15978	18339	26566	693.7	8817.7	9788.1	11237.9	16978.3
D2 – 20 June	1016	17104	11798	12909	22258	607	10571	11798.9	12909.5	14373.2
D3 – 30 June	1235	10792	12469	13642	21147	708	6595.2	7672.7	8266.1	13774.6
V2 –JS - 9305										
D1 – 10 June	1389	12394	13528	15048	25641	693.7	7584.7	8181.5	9251.1	16250.5
D2 – 20 June	1016	16558	17814	19824	21351	607	10024.4	11128.9	12745.6	13866.9
D3 – 30 June	1235	10108	11249	12469	21133	708	6222.9	6902.6	7672.7	13794.3
V3 –JS - 9305										
D1 – 10 June	1389	13052	14454	15978	24978	693.7	7902.2	8817.7	9788.1	15942.7
D2 – 20 June	1016	15658	16608	18828	21823	607	9665.9	10214.5	11969.6	14135.7
D3 – 30 June	1235	9637	11249	12469	21133	708	6003	6902.6	7672.7	13794.3

REFERENCES

Ahmad, M., Anwar, M., Rahman, M. and Alam, M. (2010). Yield and yield components of soybean varieties as affected by different sowing dates.American- Euresian Journal of Agronomy. 3 (1):25-29.

Anonymous (2009). Crop Survey conducted by SOPA (The Soybean Processors Association Indore. (M.P.) of India. September 16 to 24.

Anonymous (2010). All India Coordinated Research Projects on Soybean. Directorate of Soybean Research, ICAR, Indore.9-10.

Anonymous (2013). The Soybean Processors Association of India (SOPA). www.sopa.org.

Anonymous (2013a) **and Anonymous** (2013b). Food and Agriculture Organization (FAO) of the United Nations. www.faostat.org.

Anonymous (2015). Krishi Darshika, I.G.K.V., Raipur (C.G.). pp 4. Anonymous 2010. Mention wheather it is from Annual reportor from status report. Directors Report and summary tables of experiments on soybean.15.

Baisakh, B. and Dash, G. B. (1992). Performance of promising genotype of Soybean in hilly region of Orissa. Indian J. Agric. Sci. 62 (5):335-336.

Barik, T. and Sahoo, K.C. (1989). Response of Soybean to date of sowing and spacing. Indian J. Agron.34 (4):464-466.

Benati, R., Danuso, F., Amuduci, M. T. and Venturi, G. (1988). Effects of sowing date on yield and yield components of Soybeans. Rivistadi Agronomia. 22 (1):3-12.

Black, C.A. (1965). Method of soil analysis. Amar. Agron. Inc. Madeson, Wisconsin, USA. pp. 131-137.

Chauhan, G.S., Verma, N.S. and Bains, G.S. (1988). Effect of extrusion processing on the nutritional quality of protein in rice legumeblends. Nahrung 32:43.

Deokar, P., Guhey, A. and Patil, S. (2009). Physiological basis of seed yield variation in soybean (*Glycine max* (L.)Merill.). International J. Plant Sciences 4 (2):596-598.

Ghadekar, S.R. (2001). Crop Climatology, Meteorology (Ed. S.R. Ghadekar). Agromet Publishers Nagpur 186-193. Isoda, A., Mori, M., Matsumoto, S., Li, Zhiyuan, Wang, Peiwu 2006. High yielding performance of soybean in Northern Xinjiang, China, Plant-Production- Science. 9 (4):401-407.

Jackson, M.L. (1967). Soil chemical analysis. Prentice Hall of India Pvt. Ltd. New Delhi. Jasani, K.P., Patel, M.P. and Patel, H.P. 1993.Growth and yield of soybean as influenced by sowing period and seed rate. Indian J. Agron. 38 (4):670- 672

Kumar, A., Pandey, V., Shekh, A.M. and Kumar, M. (2008). Radiation use efficiency and weather parameter influence during life cycle of soybean (*Glycine max.* [L] mirrll) production as well accumulation of dry matter, American- Eurasian Journal of Agronomy 1(2): 41-44.

Kumar, A., Pandey, V., Shekh, A.M. and Kumar, M. (2008a). Radiation Use efficiency and weather parameter influence during life cycle of Soybean (*Glycine max.* [L] Merrill) production as well accumulation of dry matter .American Eurasian Journal of Agronomy 1 (2):41-44.

Kumar, A., Pandey, V., Shekh, A.M. and Kumar, M. (2008b). Growth and yield response of soybean (*Glycinemax* L.) in relation to temperature, photoperiod and sunshine duration at Anand, Gujrat India American- Eurasian Journal of Agronomy1(2):45-50.

Kumar, A., Pandey, V., Shekh, A.M. and Kumar, M. (2008c). Correlation study in soybean with response to prevailing weather parameter, agrometeorological indices to seed and stover yield at Anand. American-Eurasian Journal of Agronomy 1(2):31-33.

Kumar, M. and Singh, D. (2007). Agroclimatic models for growth and yield of soybean (*Glycine max* (L.) Merill.) Annals of Biology.23 (2):173-16.

Lawn, R.J. (1989). Agronomic and physiological constraints to the productivity of tropical grain legumes and prospects for improvement. Exptl. Agric, 25 (2):509-528.

Olsen, S. R., Cole, C.V., Watanable, F.S. and Dean, L.A. (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate. United State Department of Agriculture, CIRC, Washington D. C.

Panse, V.G. and Sukhatme P.V. (1967). Statistical method for Agricultural workers. Second Edition Indian Council of Agricultural Research, New Delhi.

Ramesh, P. and Gopalaswamy, N. (1992). Effect of planting date and irrigation regime on growth, yield attributes and yield of Soybean. Indian J. Agron. 37 (1):126-129.

Sadeghi, M.S., and Niyaki, N.A.S., (2013). Effects of planting date and cultivar on the yield and yield components of soybean in north of iran. ARPN J. of agricultural and biological science, asian research publishing network (ARPN). 8(1): 81-85.

Sharma, J.K., Namdeo. K.N. and Nakhtore, C.L. (1991). Influence of sowing dates and cultivars on growth and yield of soybean .Research and Development Reporter 8 (2):102-106.

Singh, A., Rao, V.U.M., Singh, D. and Singh, R. (2007). Study on agrometeorological indices for soybean crop under different growing environments. Journal of Agrometeorology, 9 (1):81-85.

Singh, B. and Singh, G. (1991). Effect of dates of sowing on grain yield of soybean under Nagal and condition.Legume Res. 14 (4):185-186. Singh, K.P. and Bajpai, R.P. 1992. Effects of sowing date on yield of rainfed soybean Indian J. Agron. 37 (1):149.

Souza, P., Ribeeiro, A., Rocha, E., Falarias, J., Loureiro, R.,Bispo, L. (2009). Solar radiation use efficiency by soybean under field condition in the Amazonregion. Pesquisa. Agropecuattia Brasilereira. 44 (10):1211-1218.

Subbiah, B.V. and Asija, G.L. (1956). A rapid method for estimation of nitrogen in soil. Current Science 26 : 259-260.

Tandale, M. and Ubale, S. (2007). Evaluation of effect of growth parameter. Leaf area index (LAI), Leaf area Duration (LAD), Crop growth rate (CGR) on seed yield of soybean during *Kharif* season. International J. Agri. Sci.3 (1):119-123.

Yari, V., Frnia, A., Maleki, A., Moradi, M., Naseri, R., Ghasemi , M., and Lotfi, A., (2013a). Yield and yield components of soybean cultivars as affected by planting date, bulletin of environment pharmacology and life science 2(7): 85- 90

Yari, V., Frnia, A., Maleki, A., Moradi, M., Naseri, R., Ghasemi , M., and Lotfi, A., (2013b). Yield and yield components of soybean cultivars as affected by planting date, bulletin of environment pharmacology and life science 2(7): 85- 90.

Yari, V., Frnia, A., Maleki, A., Moradi, M., Naseri, R., Ghasemi , M., and Lotfi, A., (2013c). Yield and yield components of soybean cultivars as affected by planting date, bulletin of environment pharmacology and life science 2(7): 85- 90.

Yari, V., Frnia, A., Maleki, A., Moradi, M., Naseri, R., Ghasemi , M., and Lotfi, A., (2013d). Yield and yield components of soybean cultivars as affected by planting date, bulletin of environment pharmacology and life science 2(7): 85- 90.

Zargar, M., Mafakheri, S., and Shakouri, J.M., 2011. Response of soybean varieties to different planting dates, middle- east journal of scientific research 8(1): 161-164

ABUNDANCE OF ZOOPLANKTON POPULATION AND FISH PRODUCTION IN INTEGRATED FISH LIVESTOCK FARMING SYSTEMS

Arachana, A.P. Sharma* and Malobika Das

S.V.B.P.Univ. of Ag. & Tech., Meerut, India
** College of Fishery Science,*
G.B. Pant University of Agriculture & Technology, Pantnagar, India

Received-16.10.2015, Revised-25.10.2015

Abstract: Zooplankton occupies a central position in the food webs of aquatic ecosystem. They do not only form an integral part of the lentic community but also contribute significantly, the biological productivity of the fresh water ecosystem. Very high zooplankton density was recorded in two integrated systems i.e. the duck-fish and chicken-fish integrated farming. The zooplankton population was analysed in terms of density, species composition, and seasonal abundance. Both the integrated ponds, supported luxurious population of zooplankton almost during the entire study period. A total of 22 and 25 species were recorded from duck-fish and chicken-fish integrated ponds, respectively. The total fish production recorded from the ponds was also high. The present findings suggest that integrated farming systems support large population of natural fish food organisms which results in high growth rate and overall production of fish.

Keywords: Fish production, Farming system, Population, Zooplankton

INTRODUCTION

The importance of the zooplankton is well recognized as these have vital role in food chain and play a key role in cycling of organic matter in an aquatic ecosystem (Shailendra *et. al.,* 2010). Fresh water zooplankton is of utmost significance in aquaculture, as they form important source of food for most fish species (Mageed and Sonsawa 2002). Management practices have been evolved to produce the desired level of zooplankton under nursery and grow out phases of fish rearing. They are a valuable source of protein, amino acids, lipids, fatty acids and minerals for fish. The significance of zooplankton is further increased in the integrated farming systems, where no supplementary feed is provided to the fishes and fish growth depends primarily on natural fish food organisms, particularly the zooplankton. The zooplankton population has been widely investigated in fresh water ecosystems and under extensive/semi-intensive farming systems (Tavares et. al. 2011, Ikpi et. al. 2013). Integration of livestock with fish farming produces altogether different characteristics (Singh and Sharma 1998). The daily input of the excreta, wastes and spillover feed of birds might produce alterations in the zooplankton community and thus affect the growth rate and production of fish. The findings are reported in the paper.

MATERIAL AND METHOD

The present investigation was carried out in two completely integrated, fish-duck and fish-chicken farming ponds. High growth variety of broiler chicken (Bab Cock) and egg laying exotic variety of duck (Khaki Campbell) were used for integration with fish. The ducks and chicken were raised in wooden houses made-up of split bamboo, erected directly over the ponds. Both the ponds were stocked under poly-culture farming system of Indian major carps (*Labeo rohita, Catla Catla* and *Cirrhinus mrigala*) and exotic carps (*Cyprinus carpio, Hypophthalmichthys molitrix and Ctenopharyngodon idella*). The stocking proportion of different fish species is given in fig. 1. The stocking density of fish in both the ponds was 10,000 fingerlings/ha, while the stocking density of ducks and chicken was kept as 700 and 500 no. /ha, respectively. No fertilizer or manure was added in the integrated ponds; artificial feeding of fish was also not resorted to. Both ponds were managed as per standard farm management practices. Standard methods (APHA 1985) were used for the analysis of various physico-chemical the parameters. For the zooplankton community analysis, fifty liters of water was filtered, from different places in each pond, through plankton net made of bolting silk cloth no. 25. The collected sample was centrifuged for 15 minutes and concentrated samples were preserved in formol. The following equation was used to enumerate the zooplankton density (Welch 1948).

$$N = \frac{(a \times 1000)\, c}{l}$$

Where, N = density (ind/l)
a = mean number of zooplankton per counting unit of 1 mm^2
l = volume of water filtered in litres
c = volume of concentrate

*Corresponding Author

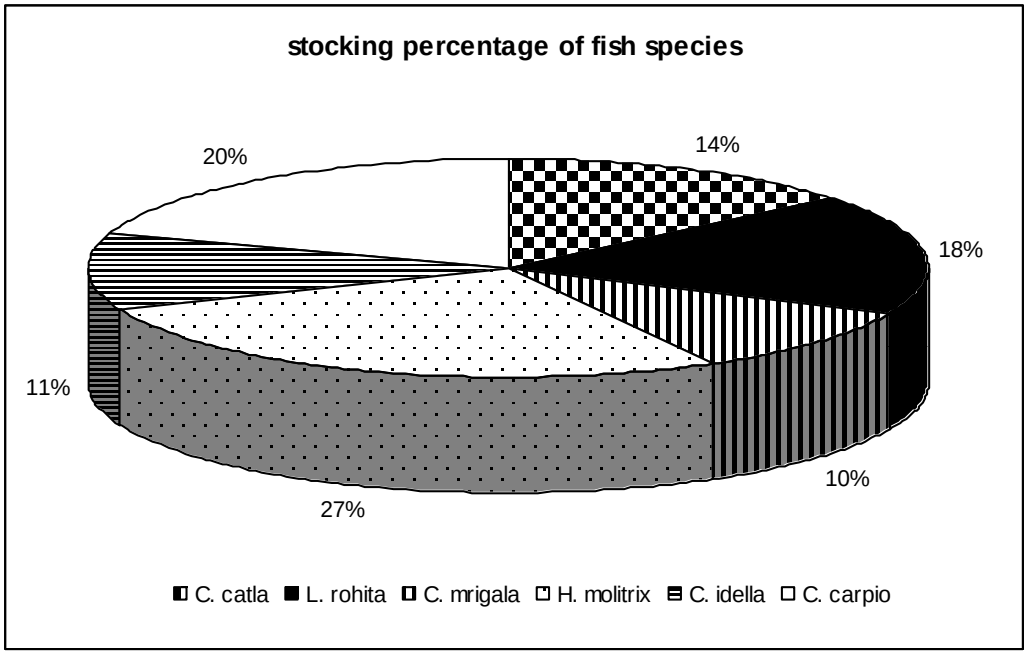

Fig.1 Stocking proportion of different species in duck-fish and chicken-fish ponds.

RESULT AND DISCUSSION

The important physico-chemical parameters were analysed regularly during the study period. Table1. Summarizes the mean annual range of the different parameters.

Table 1. Range of important physico-chemical parameters of pond water

Parameter	**Duck fish pond**	**Chicken-fish pond**
Water temperature (^{0}C)	16.0-32.5	16.0-32.5
Secchi transparency (cm)	23.5-40.0	18.0-26.5
pH	7.0-7.6	7.0-7.8
Dissolved oxygen (mg/l)	4.8-6.4	4.6-6.2
Free CO_2 (mg/l)	8.6-18.0	4.0-12.0
Alkalinity (mg/l)	165-210	80-220
NH_3 – N (mg/l)	0.05-0.5	0.04-0.6
NO_3 – N (mg/l)	0.04-0.50	0.11-0.56
PO_4 - P (mg/l)	0.04-0.30	0.04-0.35

A critical analysis of the water quality reveals highly conducive conditions for the growth and survival of zooplankton and fish. Majority of physic-chemical variables are in favourable range**.** Both the ponds are rich in nutrients for sustaining large populations of zooplankton.

Total zooplankton population

The total population density of zooplankton varied between 150.4 and 493.0 ind/l in duck-fish pond, while in chicken-fish pond it ranged from 172.0 to 756 ind/l (Fig 2). The lowest and highest population was recorded in July and January, respectively in both the ponds. The zooplankton population in both the ponds remained low during the monsoon season, increasing during the pre-winter season and attained peak values in January. The zooplankton communities of the two ponds under present study were similar in terms of species composition and resemble to the tropical water bodies. Both the pond supported luxurious population of zooplankton High zooplankton density in integrated fish- cum-duck farming has also been reported by Chauhan *et al.* (1998), Kumar *et. al.* (2012).

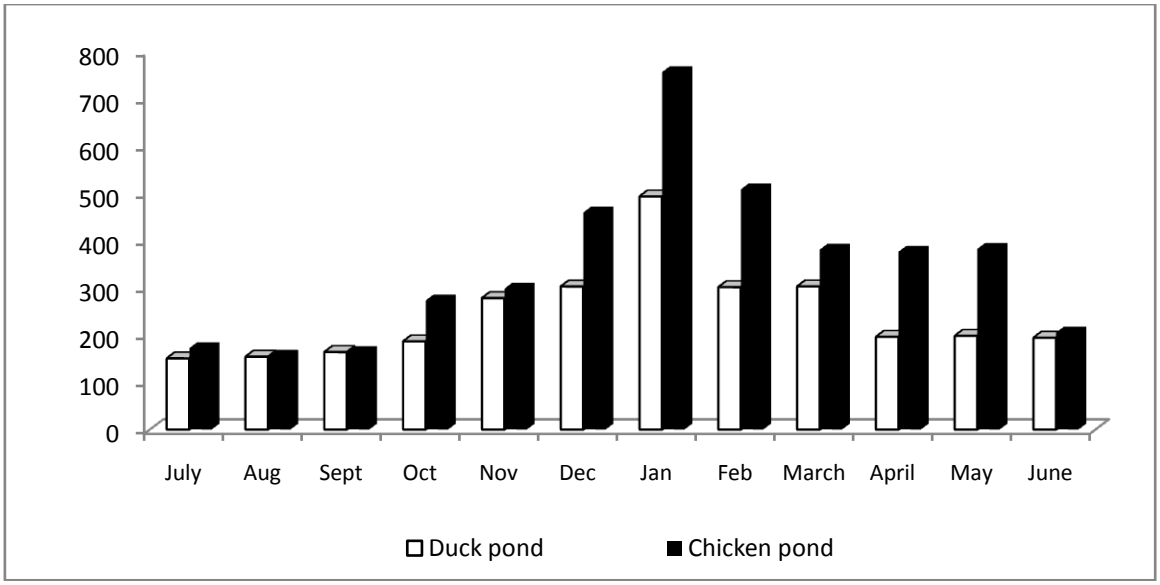

Fig.2. Variation in total density of zooplankton in duck-fish and chicken-fish ponds.

Species composition

A total of 27 species were identified from both the integrated farming ponds. 17 species belonged to rotifera, 8 to cladocera while the copepoda was represented by only 2 species (Table 2).

Table 2. List of zooplankton species recorded from duck-fish and chicken-fish integrated ponds.

Name of species	Duck–fish pond	Chicken –fish pond
Brachionus bidentata	+	+
B. calyciflorus	+	+
B. plicatilis	+	+
B. caudatus	+	+
B. angularis	+	+
B. quadridentatus	+	-
B. falcatus	+	+
B. diversicornis	+	+
B. havanensis	-	+
Philodina sp.	+	+
Polyarthra multiappendiculata	+	+
Notholca sp.	+	+
Asplanchna brightwelli	+	+
Filinia longiseta	+	+
Keratella tropica	+	+
Keratella procurva	-	+
Epiphanes sp.	+	+
Daphnia magna	+	+
D. pulex	+	-
D. lumholtzi	-	+
Bosminopsis sp.	+	+
Moina micrura	+	+
Alona sp.	-	+
Chydorus sphericus	-	+
Scapholeberis kingi	+	+
Mesocyclops hyalinus	+	+
Diaptomus sp.	+	+

+present, -absent

Among the rotifers, the species belonging to genus *Brachionus* were the most common and dominant in both ponds with a total of 8 species. It is important to note that *Brachionus spp* are commonly found in nutrient rich or heavily fertilized waters and are nutrient tolerant (Singh et al. 1997, Rahman and Hussain 2008).

Fish Production:
Under duck-fish rearing, a gross fish production of 6154 kg/ha/yr was obtained at 700 no. /ha stocking density of ducks. *C.carpio*, with a production of 37.1% was the largest contributor, followed by silver carp (25.9%). Chand *et. al.* also reported high fish production in duck fish integrated system with stocking density of ducks @400/ha.The details are given in table 3.1.

Table 3. Fish Production details in duck pond

Details	Fish Species					
	Catla	Rohu	Mrigal	S. Carp	G. Carp	C. Carp
Nos. stocked	100	126	70	200	75	140
Nos. harvested	86	108	58	180	66	124
Survival %	86	85.7	82.8	90	88	88.4
Initial average weight (g)	36.7	7.2	3.4	51.0	5.0	74.5
Final average weight (g)	230	225	245	520	614	451
Total weight harvest (kg)	29.65	22.920	13.500	88.819	60.690	127.200

Details	Duck-fish pond
Area of pond	0.0557 ha
Stocking density	10000 fingerlings / ha 700 ducks / ha
Production per pond / y	342.779 kg fish/y
Gross production / ha/y	6154 kg fish

In chicken fish integrated pond, gross fish production of 4483.2 was obtained (Table 3.2). Silver carp contributed maximum to the total fish production (25%). Common carp, mrigala, grass carp, rohu and catla contributed 21.14, 18.28, 13.29, 13.09 and 9.16%, respectively.

Table 4. Fish Production details in chicken-fish pond

Details	Fish Species					
	Catla	Rohu	Mrigal	S. Carp	G. Carp	C. Carp
Nos. stocked	56	106	120	90	48	78
Nos. harvested	43	95	107	79	36	65
Survival %	76.78	89.6	89.1	81.8	75	83.3
Initial average weight (g)	41.6	6.4	4.2	11.8	4.0	70.5
Final average weight (g)	200	106	157	220	225	298
Total weight harvest (kg)	13.81	19.7	27.5	37.67	20.015	31.9

Details	Chicken–fish pond
Area of pond	0.0336 ha
Stocking density	12000 fingerlings / ha 500 chicken / ha
Production in pond	150.638 kg
Gross production / ha/yr	4483.2 kg fish / ha / yr

Table 5. Fish Production details in control pond

Details	Fish Species					
	Catla	Rohu	Mrigal	S. Carp	G. Carp	C. Carp
Nos. stocked	40	80	40	120	40	80
Nos. harvested	36	75	35	105	35	75
Survival %	90.0	93.8	87.5	87.5	87.5	93.8
Initial average weight (g)	40.5	10.2	9.5	21.2	90.0	40.8
Final average weight (g)	215	140	155	350	451	430
Total weight harvest (kg)	15.5	21.0	10.8	79.8	37.7	64.5
Details	Control pond					
Area of pond	0.05 ha					
Stocking density	8000 fingerlings / ha					
Production per pond	223.3 kg					
Gross production / ha/yr	4466.0					

CONCLUSION

In light of the above it can be concluded that nutrient rich integrated fish livestock farming systems produce large populations of zooplankton and are sustainable in terms of food availability to the fish cultured. The quality of the zooplankton produced is also good and suitable for fish growth. As a result the growth of fish and the total fish production is higher as compared to the ponds without livestock integration, even without any kind of fertilization and supplementary feeding. Fish grow rapidly in tropical waters and if natural fish food i.e. plankton, produced due to nutrient rich wastes, replaces the need for expensive supplementary feed, the cost of production could be minimized.

REFERENCES

APHA (1985). Standard methods for examination of water and waste water. 16th ed. American Public Health Association. New York.

Chand, B. K., Goswami, A., Biswas, P. K., Biswas, P. and Patra, B. C. (2006). Effects of stocking levels of ducks on production of Indian Major Carps in village ponds under duck-fish integrated system in West Bengal state of India. *Livestock Research for Rural Development.*18(6).Retrieved October 12, 2010, from http://www.lrrd.org/lrrd18/1/chan18006.htm

Chauhan, R.S., Sharma, A.P. and Singh, U.P. (1998). Recycling of duck Excreta and its impact on fish production. *Him. J. Env. Zool.* 12: 43-48.

Ikipi, Gabriel Vjong, Benedict Obeten Offem and Irom, Bassey Okey (2013). Plankton distribution and diversity in tropical earthen fish ponds. *Env. and Natural Resources Research.* 3 (3).

Yaswanth, Kumar, J., Chari, M S and Vardia, H K (2012). Effect of integrated fish-duck farming on growth performance and economic efficiency of Indian major carps. *Livestock Research for Rural Development.* 24 (12).

Mageed, A. Adel and Sonsowa, H. (2002). Relationship between phytoplankton, zooplankton and fish culture in fresh water fish farms. *Egypt. J. Aquat. Biol. & Fish*. 6 (2): 183-202.

Sharman, Rahman and Afzal Hussain, M. (2008). A study on the abundance of zooplankton of a culture and non culture pond of Rajshahi University campus. *Univ. j. Zool. Rajshahi Univ.* 27: 35-41.

Sharma, A.P., Singh, U.P., Chauhan, R.S. and Archana (2001). An appraisal of integrated fish-livestock farming in tarai region. 215-230 pp. *In*: Singh U.P., R.S. Chauhan and A.P Sharma (eds). Proc. National Seminar on Fish Health Management and Sustainable Aquaculture. 1-2 November, College of Fishery Sciences, Pantnagar.

Singh, C.S. and Sharma, A.P. (1991). Energy flow with a perspective to fish production in Nanak Sagar reservoir. Final Report, ICAR project, Mimeo, 100 p.

Singh, V.K. and Sharma, A.P. (1998). Community structure of plankton in fish ponds manured with 3 organic manures. *Him. J. Env. Zool*. 12:91-98.

Sharma, Shailendra; Siddique, Anis; Singh, Karam; Chouhan, Meenakshi; Vyas, Amrit; Solnki, C.M. (2010). Population Dynamics and Seasonal Abundance of Zooplankton Community in Narmada River (India*). Researcher*. 2(9): 1-9.

Tavares Sipauba, L.H, Donadon, A.R.V and Milan, R.N. (2011). Water quality and plankton populations in an earthen polyculture pond. *Braz. J. Biol.* 71(4), Saco Carlos.

Welch, P.S. (1952). Limnology. McGraw Hill Co., New York: 511p.

SEASONAL ABUNDANCE AND POPULATION DYNAMICS OF THE *SCIRTOTHRIPS DORSALIS* AND *APHIS GOSSYPII O*N CHILLI

Mithlesh Kumar Sahu*, Yugal Kishore Yadu and Devender Verma

Indira Gandhi Agricultural University, Raipur, Chhattisgarh 492 006

Received-03.10.2015, Revised-11.10.2015

Abstract: The experiment was conducted during *rabi-summer* season 2010-11 at Mango orchard, Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G). The thrips, *Scitrothrips dorsalis* and aphid, *Aphis gossypii* were recorded as major insect pests in chilli crop. The in festation of thrips began in the first week of February (5th Standard Meteorological Week) and reached to its peak in 3rd week of March. (12th SMW), that of aphid began in the first week of February (5th SMW) and reached its peak in the 2nd week of February (6th SMW). The abiotic factors of the environment i.e. evening relative humidity had significant negative correlation with the population of thrips. The aphid population was negatively correlated to minimum temperature and positively influenced by morning relative humidity.

Keyword: Population dynamics, Chilli thrips, Aphid

INTRODUCTION

Chilli is one of the important cash crops grown in almost all parts of the country. It is widely grown in the tropics and subtropics and also under glass houses in temperate regions. The plants are very sensitive to excessive rainfall, water lodging and frost. The ideal condition of its cultivation is well drained loamy soil rich in organic matter but can also be grown in much type of soils. It is commonly used as condiments, the pungency in chilli is due to a substance "Capsaicin". It contains high amount of vitamin A, C, E, B_1, B_2, B_3 and Oleoresin. Oleoresin is used in pain balm, vapours etc. (Kumar *et al*., 2005).

India is the largest producer of chilli. Chilli production level is however around 1.1 million tonnes annually. It is cultivated in all states and union territories of the country. The productivity is higher in the states of Andhra Pradesh and Tamil Nadu where chilli is grown under irrigated conditions than in Maharashtra and Karnataka, where the crop is raised mainly under rain fed situations.

Chilli is grown in all part of Chhattisgarh during rainy, spring and summer season. In this state the chilli production was 109908 metric tonnes from an area of 9187.25 hectares with average productivity of 11.97 metric tonnes per hectare in the year 2008-09 (Anonymous, 2010).

It is most imperative to know the current insect pest scenario of chilli crop. Seasonal abundance study on the prevalent and new emergent insect pests, in relation to change in abiotic and biotic factors and their influence on the population fluctuation of harmful insect pests like thrips, (*Scirtothrips dorsalis*); aphid, (*Aphis gossypii*) which are the important pests of chilli (Baloch *et al*., 1994).

In India 20 insect pests are known to infest chilli crop, which affect the crop both quantitavely and qualitatively. *Scirtothrips dorsalis* Hood known as "chilli thrips" is one of the limitations for higher production of chilli crop and the losses in the yield of green chillies, from 60.5 to 74.3 per cent (Patel and Gupta, 1998).

The climatic factors play substantial role in the biology of any pest, of which temperature is the most crucial abiotic factor influencing the life of any organism. It is rather difficult to find a direct relationship between any single climatic factor and pest activity because the impact of weather elements on pest is usually confounded (Benerji, 1972). However temperature, sunshine, rainfall, relative humidity and wind speed are the chief weather parameters that largely direct the activity of insects. The present work includes the study of the population dynamics of the thrips and aphid with a view to provide sound base to the IPM strategy.

MATERIAL AND METHOD

The experiment was conducted during *rabi-summer* season 2010-11 at mango orchard, Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G). The general climate is hot with mid winter followed by monsoon period of about four to five months. It receives an average rainfall of 1000-1350 mm per annum mostly concentrated during June to September with occasional showers in winter. The maximum temperature goes to high as 46^0C during the summer month and minimum as low as 6^0C during the winter. The atmospheric humidity is high from June to October.

The population dynamics of chilli thrips and aphid was studied for which an experiment was laid out in uniformly sized plots measuring of 10m x 5m replicated 4 times. Variety Pusa jwala was grown untreated plots at 45x45 cm row to row & plant to plant spacing during rabi-summer 2010-2011. Five

*Corresponding Author

plants per plot were selected randomly and tagged to record the population of insect pests during the experimental period. Observations were recorded for initiation of pest incidence and the peak period of infestation, later, the influence of abiotic factors of the environment on the pest population was studied.
Population of chilli thrips and aphid were recorded after 30 days of transplanting at weekly intervals from 5 tagged plants selected at random during morning hours between 7.30 to 9.30 am, when most of the insect pests are less active.

Statistical analysis of data
Population data of chilli thrips and aphid thus obtained were subjected to statistical analysis to find out the influence of a biotic factor on population computing the coefficient. The calculated t-value obtained was compared with the tabulated t-value at 5 per cent level of significance.

RESULT AND DISCUSSION

The data on intensity and population fluctuation of thrips and aphid along with prevailing weather condition of crop season was recorded. Chilli crop variety "Pusa Jwala" was sown on 16 November during *rabi-summer* season 2010-2011, to study population dynamics on chilli crop. The thrips (*Scirtothrips dorsalis)* and aphid (*Aphis gossypii*) were found from seedling to reproductive stage of the crop.

Thrips – *Scirtothrips dorsalis* (Thysanoptera: Thripidae)
Periodical observation on the thrips incidence showed that the first appearance of thrips population was started from first week of February (5^{th} SMW). Initially there were 1.05 thrips per plant and was reached maximum of 279.55 thrips per plant in the third week of March (12^{th} SMW). The thrips population was recorded during the entire growth period, the minimum population of thrips (4.75) was recorded in fourth week of May (22^{th} SMW).
The Correlation between population of thrips and temperature was found negatively non-significant with maximum and minimum temperature at 5% level with 'r' values as -0.041 and -0.150, respectively. The peak activity of the thrips was recorded during third week of March, which was associated with average maximum temperature of 37 ^{O}C and minimum temperature of 14^{0}C .
The Correlation between population of thrips and average relative humidity morning was found to be negatively non-significant at 5% level with 'r' value -0.116 while it was negatively significant with evening relative humidity with 'r' value -0.492. The peak activity of the thrips was recorded during third week of March, which was associated with average morning relative humidity of 59% and average evening relative humidity of 24 per cent.
The correlation coefficient between population of thrips and total rainfall was worked out negatively correlated r = (-) 0.040 but non-significant at 5% level. The peak activity of the thrips was observed during third week of March, which was associated with 0.40 mm rainfall.
The present finding are in conformity with earlier worker, Ettouradjou (2003) who reported that during *rabi-summer* (2002-2003), activity of thrips on chillli recorded throughout the crop season i.e. January to June. The peak activity of chilli thrips was more pronounced during March to May.
Our findings are in agreement with those of Panickar and Patel (2001) they reported that maximum temperature had negative effect on thrips population. While the present findings are in disagreement with the findings of Varadharajan and Veeravel (1995), they reported that maximum temperature had positive effect on thrips population but Shukla (2006), reported the population trend of *S.dorsalis* in chilli crop indicated not strong correlation with temperature and relative humidity.

Table 1. Pest succession of major insect pest of chilli and meteorological data during (2010-2011)

Date	SMW	Thrips pop./plant	Aphid pop./plant	Temperature(^{o}C)		Rainfall (mm)	Relative humidity (%)	
				Max.	Min.		Morning	Evening
01.02.2011	5	1.05	15.15	29.9	14	0.00	82	35
08.02.2011	6	4.85	94.90	31.4	13.1	0.00	83	27
15.02.2011	7	48.25	38.30	32.1	16.8	0.00	74	31
22.02.2011	8	45.25	8.00	27.1	15.7	12.20	84	51
28.02.2011	9	25.65	38.60	32	16.5	0.00	81	30
04.03.2011	10	34.65	33.45	35	19.2	0.00	76	30
08.03.2011	11	102.65	2.75	34.6	16.6	0.00	68	20
15.03.2011	12	279.55	2.90	37	21.2	0.4	59	24
23.03.2011	13	124.85	9.70	37.6	19.3	0.00	62	11

29.03.2011	14	58.30	9.00	37.3	21	0.00	56	18
05.04.2011	15	48.45	7.60	36.9	22.1	23.8	72	31
12.04.2011	16	47.25	5.85	36.8	23.6	51.2	76	39
19.04.2011	17	35.30	4.30	20	13.1	0.00	42	13
25.04.2011	18	9.20	4.10	40.3	26	0.00	57	22
03.05.2011	19	6.80	4.05	41	23	0.00	77	12
10.05.2011	20	6.60	3.75	41.77	26.51	2.77	59	20
17.05.2011	21	5.95	3.20	41.9	27.22	2.65	52	23
24.05.2011	22	4.75	2.98	41.9	28.05	0.00	53	24

Table 2. Coefficient of correlation among chilli thrips and weather parameters

SMW	**Thrips pop./plant**	**Temperature ^{o}C**		**Rainfall (mm)**	**Relative humidity (%)**	
		Max.	**Min.**		**Morning**	**Evening**
5	1.05	29.9	14	0	82	35
6	4.85	31.4	13.1	0	83	27
7	48.25	32.1	16.8	0	74	31
8	45.25	27.1	15.7	12.2	84	51
9	25.65	32	16.5	0	81	30
10	34.65	35	19.2	0	76	30
11	102.65	34.6	16.6	0	68	20
12	279.55	37	21.2	0.4	59	24
13	124.85	37.6	19.3	0	62	11
14	58.3	37.3	21	0	56	18
15	48.45	36.9	22.1	23.8	72	31
16	47.25	36.8	23.6	51.2	76	39
17	35.3	20	13.1	0	42	13
18	9.2	40.3	26	0	57	22
19	6.8	41	23	0	77	12
20	6.6	41.77	26.51	2.77	58.71	19.57
21	5.95	41.9	27.22	2.65	51.85	23.28
22	4.75	41.9	28.05	0	53.28	23.85
CD at 5% level		**-0.041**	**-0.150**	**-0.040**	**-0.116**	**-0.492***

Note: *, Significant at 5% level

Table 3. Coefficient of correlation among aphid and weather parameters

SMW	**Aphid pop./plant**	**Temperature ^{o}C**		**Rainfall (mm)**	**Relative humidity (%)**	
		Max	**Min**		**Morning**	**Evening**
5	15.15	29.90	14.00	0.00	82	35
6	94.90	31.40	13.10	0.00	83	27
7	38.30	32.10	16.80	0.00	74	31
8	8.00	27.10	15.70	12.2	84	51
9	38.60	32.00	16.50	0.00	81	30
10	33.45	35.00	19.20	0.00	76	30
11	2.75	34.60	16.60	0.00	68	20
12	2.90	37.00	21.20	0.40	59	24
13	9.70	37.60	19.30	0.00	62	11
14	9.00	37.30	21.00	0.00	56	18
15	7.60	36.90	22.10	23.80	72	31
16	5.85	36.80	23.60	51.20	76	39
17	4.30	20.00	13.10	0.00	42	13
18	4.10	40.30	26.00	0.00	57	22
19	4.05	41.00	23.00	0.00	77	12

20	3.75	41.77	26.51	2.77	59	20
21	3.20	41.90	27.22	2.65	52	23
22	2.98	41.90	28.05	0.00	53	24
CD at 5% level		**-0.288**	**-0.518***	**-0.174**	**0.517***	**0.185**

Note: *, Significant at 5% level

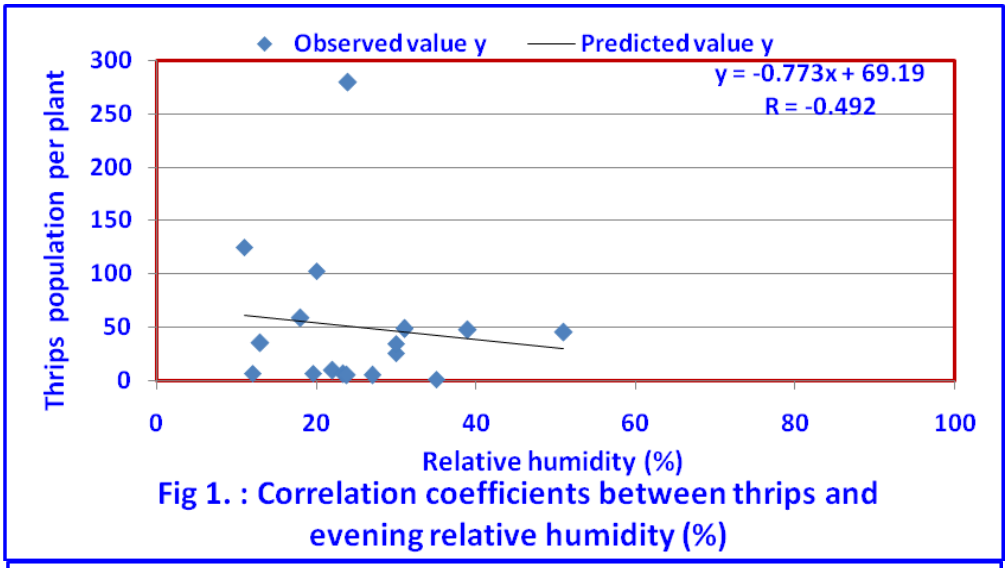

Fig 1. : Correlation coefficients between thrips and evening relative humidity (%)

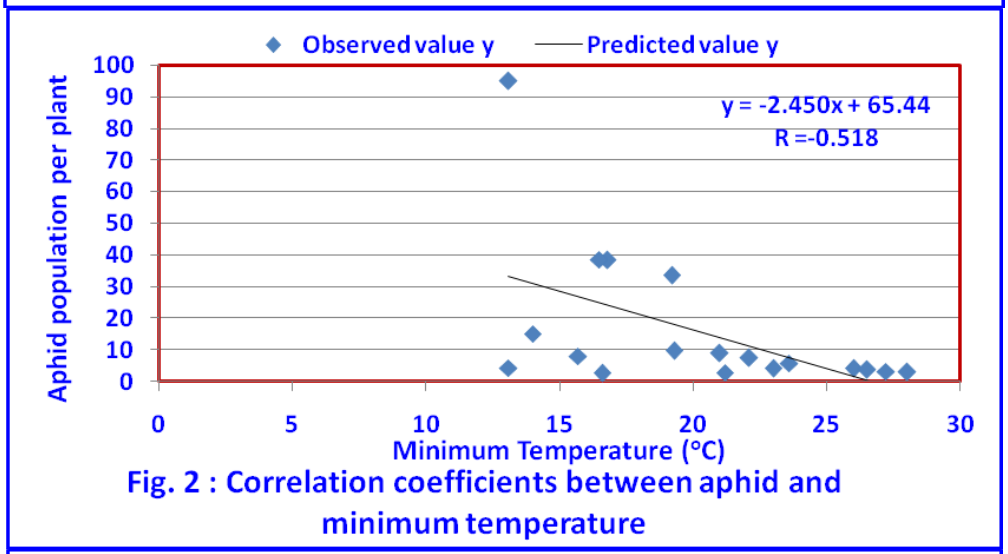

Fig. 2 : Correlation coefficients between aphid and minimum temperature

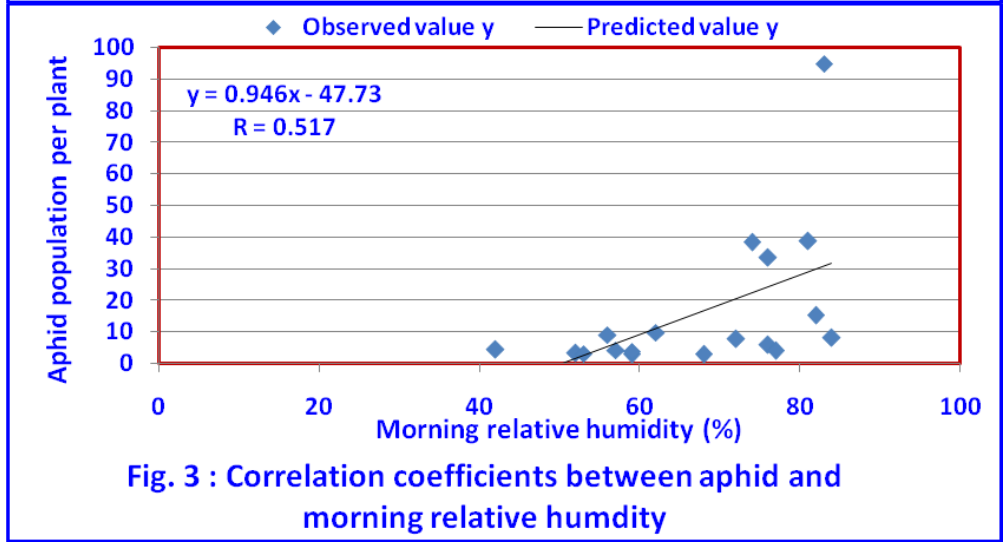

Fig. 3 : Correlation coefficients between aphid and morning relative humdity

Aphid – *Aphis gossypii* (Hemiptera: Aphidae)

The next pest appeared was aphid on the crop during the first week of February (5th SMW). The pest started its multiplication from 15.15 aphids per plant and reached peak of 94.90 aphid on three leaves per plant in the second week of February (6th SMW). There after, there was a gradual decrease in the pest density up to fourth week of May (22th SMW).

The correlation between population of aphid and temperature was found negatively non-significant in maximum and negative significant with minimum temperature at 5% level with 'r' values as -0.288 and -0.518, respectively. The peak activity of the aphid was recorded during second week of February, which was associated with average maximum temperature of 31.4 ^{O}C and minimum temperature of 13.1^{0}C.

The correlation between aphid population and average relative humidity was found positive significant in morning and negative non-significant in evening, relative humidity at 5% level with 'r' values as 0.517 and -185, respectively. The peak activity of the aphid was recorded during second week of February, which was associated with average relative humidity of 83% and 27% in morning and evening, respectively.

The correlation coefficient between population of aphidand rainfall was worked out negatively correlated (r = (-) 0.174) and non-significant at 5% level. The peak activity of aphid was recorded during second week of February, which was associated with 00.0 mm rainfall.

The present findings on aphid incidence are in conformity with those of Manjunatha *et al*. (2001) who reported that highest aphid population occurred during the first fortnight of February followed by last two weeks of January. Similarly, Saha and Raychaudhari (1995) also recorded maximum aphid population on chilli at pre-flowering stage during January to March.

REFERENCES

Anonymous (2010). http://www.techno-preneur.net/information-desk/sciencetech-magazine/2010/dec10/Prospects.pdf

Baloch, H.B.; Baloch, L.S.; Rustamani, M.A.; Hussain, T.; Talpur, M.A. and Rao, S.A. (1994). "Insect pests associated with *Capsicum annum* (Linn.) during summer season at Tandojam."14th Pakistan Congress of Zoology held from 1-3 Ap.1994 at Uni. of Karachi, Pakistan. *Procedding of Pakistan Congress of Zoology*.14:243-247.

Banerji, B. (1972). Rainfall and pest activity "Two and a Bud" half yearly news letters. Tea research association, Tocdai experimental station, jorhar, 19(1):44-45.

Ettouradjou, C. (2003). "Bio-efficacy of newer insecticides and decontamination of endosulfan on *capsicum annum* (L.) (chilli)" M.Sc.(Ag) thesis, IGKV, Raipur,(C.G.), pp.83.

Kumar, S.; Mani, C. and Singh, R.N. (2005). Field evaluation of omite and some other acaricides against broad mite, *Polyphagotarsonemuslatus* (Banks) on chilli under Varanasi conditions of Eastern Uttar Pradesh. *Pestology* 29(11):61-63.

Manjunatha, M.; Hanchinal, S.G. and Reddy, G.V.P. (2001). Survey of yellow mite and thrips on chilli in North Karnataka.*Insect- Environment* 6:4,178.

Panickar, B.K. and Patel, J.R. (2001). Population dynamics of different species of thrips on chilli, cotton and pigeonpea. *Indian J. Ent*. 63(2): 170-175.

Patel, N.G. and Gupta, H.C.L. (1998). Estimation of loss and management of thrips infesting chillies in Udaipur. Seminar on entomology in 21st century, Udaipur, bio-diversity, sustainability, environmental safety and Human Health, Udaipur, pp.99.

Saha, S. and Raychaudhari, D. (1995). Insect plant interaction with cotton aphid, *Aphis gossypii* Glower and chilli as a model.*Annls.Ent*. 13(2):71-86.

Shukla, A. (2006). Seasonal activity of thrips, *Scirtothrips dorsalis* on chilli crop. *Indian Journal of Tropical Biodiversity*. 14(2): 171-174.

Varadharajan, S. and Veeravel, R. (1995). Population dynamics of chilli thrips *Scirtothrips dorsalis* hood in Annamalai nagar. *Indian J. Eco*. 22(1): 27-30

IMPACT OF VARIOUS FUNGICIDES AGAINST THE ERGOT DISEASE OF SORGHUM CAUSED *BY CLAVICEPS* SP. UNDER SOUTH GUJARAT CONDITION OF GUJARAT

G.R. Bhanderi[1], Prashant B. Sandipan*[2], N.V. Patel [3] and D.K. Davda[4]

[1 & 2] Main Cotton Research Station (MCRS), Navsari Agricultural University (NAU), Surat 395 007 (Gujarat), India
[3 & 4] Sorghum Research Station, Navsari Agricultural University (NAU), Surat – 395 007 (Gujarat), India
Email: prashantsandipan@gmail.com

Received-09.10.2015, Revised-18.10.2015

Abstract: Sorghum (*Sorghum bicolor* L.) is one of the main staples for the world's poorest and most food-insecure people commonly known as Jowar. It grows well in both summer and winter, and is thus both a *rabi* and *kharif* crop. The disease reduces yield through poor seed set and causes harvesting difficulties due to sticky honeydew on seed heads and also grain quality distress heavily due to the presence of the fungal bodies. An experiment was conducted at Sorghum Research Station, NAU, Surat (Gujarat) to find out the most effective fungicide for the control of ergot disease in sorghum. From the result analysis, the ergot incidence was found significantly lower in the treatment of Hexaconazole 5% SC @ 0.005% (18.30 % & 16.85 %) respectively in both the years.

Keywords: Sorghum, Ergot, *Claviceps* sp., *Sorghum bicolor*, Fungicides, Treatment

INTRODUCTION

Claviceps sp. is an important disease of sorghum crop causes the ergot disease. Three species causing the disease have been reported, *Claviceps sorghi* in India, *C. sorghicola* in Japan, and *C. africana* in all ergot-positive countries. Sorghum is one of the main staples for the world's poorest and most food-insecure people. Sorghum is the third largest crop to be grown in India after wheat and rice. (*Claviceps africana* Frederickson, Mantle and de Milliano) is an important disease of sorghum (*Sorghum bicolor* (L.) Moench) on all continents (Bandyopadhyay *etal*., 1998) and *C. sorghicola* (Tsukiboshi *etal*., 1999). More commonly known as jowar in the Indian sub-continent, it grows well in both summer and winter, and is thus both a *rabi* and *kharif* crop. 75% of the cultivated area is devoted to the production of sorghum. Maharashtra, Karnataka, Andhra Pradesh and Madhya Pradesh are some of the regions where sorghum is grown on a massive scale.

The fungus is best known by its imperfect stage, *Sphacelia sorghi* McRae, but the perfect stage, *Claviceps sorghi*, has been described by (Kulkarni *et al*., 1976). The disease reduces yield through poor seed set and causes harvesting difficulties due to sticky honeydew on seed heads. Grain quality can be reduced through lower nutritional value and due to the presence of fungal bodies called sclerotes (ergots). Sorghum grain contaminated with sclerotes can cause toxicity when fed to livestock, particularly sows, dairy cattle and beef cattle in feedlots. Infection occurs during flowering, when spores of the fungus land on the feathery stigmas of flowers in sorghum heads (Molefe, 1975). About 7 days after infection, sticky honeydew oozes out of the flowers and drips onto leaves and the ground. When the weather is wet and/or humid, the honeydew turns white due to the production of the infective spores just above the surface of the honeydew. Ultimately (near grain maturation), the fungal mass develops into a hard fungal body - the sclerote. Ergot can occur at any time during the growing season if suitable weather conditions occur. In experiments, a constant temperature of 20°C and relative humidity close to 100% favours maximum infection (Anahosur and Patil, 1982, McLaren and Wehner 1990). Outbreaks in main heads during summer are associated with at least two days of rainy weather, with daily maximum temperatures below 28°C. There is a trend for increasing ergot severity as the temperatures drop towards the end of the growing season In this experiment, the dual purpose sorghum varieties were more preferred, which are high yielding, good grain and fodder quality. Since last two-three years, the ergot incidence was severe particularly at Surat location. Therefore, it became necessary to study the efficacy of some newer fungicides for the control of ergot disease in sorghum. So that, the necessary measures could be taken up before ergot causes severe loss/damage to the sorghum crop.

*Corresponding Author

MATERIAL AND METHOD

Experimental details

Year of Commencement & Place	*Kharif* 2014, Main Sorghum Research Station, Surat
Experimental Details	
a. Crop & variety	Sorghum GJ 38
b. Treatments	08
c. Design	RBD
d. Replication	3
e. Plot Size	Gross : 2.7 x 4.0 m Net: 1.8 x 3.7 m
f. Spacing	45 x 15 cm
Methodology	20 earhead from each of the plots were randomly selected and each of the earhead was critically examined for presence of ergot disease and intensity. The earhead were sprayed twice, first spray was done 15 days after penicle emergence and second spray was done at 15 days after first spray.

The test entries are to be scored based on the basis of severity following 1 to 9 rating scale given here under. Readings recorded on per cent disease intensity and per cent disease control.

Disease score

Score	Description
1	No grain mold
2	1-5 % grains molded in a panicle
3	6-10 % grains molded in a panicle
4	11-20 % grains molded in a panicle
5	21-30 % grains molded in a panicle
6	31-40 % grains molded in a panicle
7	41-50 % grains molded in a panicle
8	51-75 % grains molded in a panicle
9	>75 % grains molded in a panicle

Ergot

Calculate the mean severity percentage over 10 panicles for each entry. Record data on 50% flowering time (Days) and germination (%) in threshed grains by using following formula.

Visual rating has been the most common means of quantifying grain mold. Visual appraisal involves a complex of factors and can estimate severity (degree of colonization of a uniform sample indicated by signs or discoloration), incidence (proportion of grain affected), or damage (reduction in grain size), depending upon the method of assessment. Large numbers of samples have been screened using visual appraisal method since it is the quickest and easiest method (Bandyopadhyay and Mughogho 1988). Visual assessment of grain mold severity has been standardized using a common scale of well-defined units such as percentage of grain surface affected (Forbes 1986; Bandyopadhyay and Mughogho 1988).

RESULT AND DISCUSSION

Interpretation and Conclusion

In this experiment, new fungicides were evaluated against the recommended fungicides and untreated was considered as control. The lowest ergot incidence (14.07%) was recorded in the treatment of Carbendazim (50% WP) @ 0.05% and it was at par with all the treatments except Ziram 78% WP @ 0.2% and control. Highest diseases incidence (36.48%) was observed in control (Absolute). As far as the yield concerned, the highest grain was recorded in the treatment of Carbendazim 50% WP @ 0.05% which was 28.65 q/ha (Table: 1 & Graph: 1).

In Zimbabwe, benomyl at 0.2% ai. reduced ergot significantly in A-lines if they were sprayed once at heading and this control schedule was economically feasible (Frederickson, 1993).

Mclaren, 2003 found that triadimenol and triadimefon were the most effective chemicals while, Propiconazole and Tebuconazole, which are recommended in Australia, Brazil and USA for ergot control were less effective for the control of sorghum ergot. Sorghum ergot surveys were conducted from October 1999 to February 2000 to determine the incidence and severity of the disease in major sorghum-growing Indian states (Navi *et al*., 2002 a,b).

Graph 1. Indicates the per cent disease control of ergot disease of sorghum

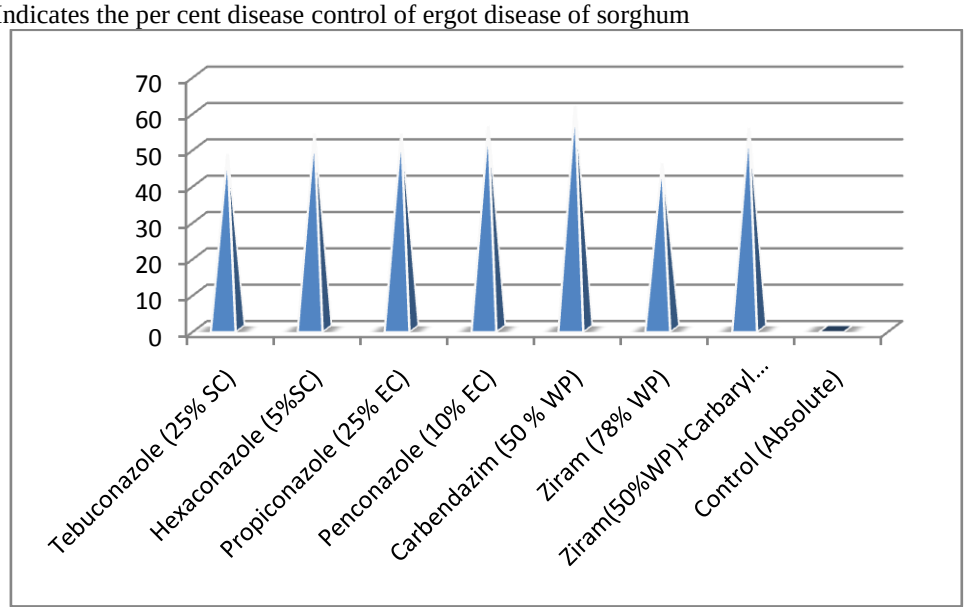

Table 1. Impact of various fungicides for the control of ergot disease of sorghum.

Sr. No.	Treatments	Conc.	Year 2014	
			Per cent Disease Intensity (PDI) (%)	Diseases control per cent (%)
T1	Tebuconazole (25% SC)	0.025%	25.61 (18.89)	48.22
T2	Hexaconazole (5%SC)	0.005%	24.07 (16.85)	53.81
T3	Propiconazole (25% EC)	0.025%	24.19 (16.85)	53.81
T4	Penconazole (10% EC)	0.01%	23.64 (16.11)	55.84
T5	**Carbendazim (50 % WP)**	**0.05%**	**21.99 (14.07)**	**61.42**
T6	Ziram (78% WP)	0.2%	26.42 (19.81)	45.69
T7	Ziram(50%WP)+Carbaryl (28%WP)	0.1%	23.79 (16.30)	55.33
T8	Control (Absolute)	00	37.02 (36.48)	0
S.Em±			**1.36**	-
CD @ 5 %			**4.12**	-
S.Em±			-	-
CD @ 5 %			-	-
CV %				-

* Figure in parenthesis is original values while those outside are arc sign transformed value.

CONCLUSION

For effective and economic management of sorghum ergot, two sprays of Carbendazim (50% WP) @ 0.05% at an interval of 15 days commencing from 15 days after emergence of the earhead.

ACKNOWLEDGEMENT

Author is highly thankful to Main Sorghum Research Station, NAU, Surat (Gujarat) for providing the required facility for conducting the experiment.

REFERENCES

Anahosur, K.H., and Patii, S.H. (1982). Effect of date of sowing on the incidence of ergot of sorghum. *Indian Phytopathology* 35:507-509.

Bandyopadhyay, R., and Mughogho, L.K. (1988). Evaluation of field screening techniques for resistance to sorghum grain molds. *Plant Disease* 72:500–503.

Bandyopadhyay, R., Mughogho, L.K., and Rao, K.E.P. (1988). Sources of resistance to sorghum grain molds. *Plant Disease* 72:504–508.

Bandyopadhyay R, Frederickson DE, McLaren NW, Odvody GN, Ryley MJ (1998) Ergot: a new disease threat to sorghum in the Americas and Australia. *Plant Disease **82***, 356–367.

Forbes, G.A. (1986). Characterization of grain mold resistance in sorghum (*Sorghum bicolor* L. Moench). Ph.D. dissertation, Texas A&M University, College Station, Texas, USA. 75 pp.

Frederickson, D.E., (1993). Effect of fungicides on infectivity of ergot conidia and on disease severity. In ICRISAT Southern and Eastern Africa Regional Program annual report 1993. Bulawayo, Zimbabwe: SADC (Southern African Development Community)/ ICRISAT (International Crops Research Institute for the SemiArid Tropics) Sorghum and Millet Improvement Program.

Kulkarni, B.G.P., Seshadri, V.S., and Hegde, R.K. (1976). The perfect stage of *Sphacelia sorghi* McRae. *Mysore Journal of Agricultural Science* 10:286-289.

Mclaren (2003). Efficacy of fungicides in the control of ergot (*Claviceps africana*) in sorghum *(Sorghum bicolor*) hybrid seed production. *South African Journal of Plant and Soil* **20** (3): 154-156.

McLaren, N.W. and Wehner, F.C. (1990). Relationship between climatic variables during early flowering of sorghum and the incidence of sugary disease caused by Sphacelia sorghi.Phytopathololology 130: 82-88.

Molefe, T.L. (1975). Occurrence of ergot on sorghum in Botswana. *Plant Disease Reporter* 59:751-753.

Navi, S. S., Bandyopadhyay R., Nageswara Rao, T. G., Tooley, P.W. (2002a). An outbreak of sorghum ergot in parts of Andhra Pradesh, India. International Sorghum and Millets Newsletter 43: 68–70.

Navi, S. S., Bandyopadhyay, R., Tonapi, V. A., Nageshwar, Rao T. G., Tooley, P. W., Reddy, R. K., Indira S, Pande, S. (2002b). Prevalence of ergot of sorghum in India. International Sorghum and Millets Newsletter 43: 70–71.

Tsukiboshi, T, Shimanuki, T, Uematsu, T. (1999). *Claviceps sorhicola* sp. nov., a destructive ergot pathogen of sorghum in Japan. *Mycol Res*. 103: 1403-1408.

GENETIC STUDIES ON HERITABILITY AND GENETIC ADVANCE FOR DROUGHT TOLERANCE IN PEARL MILLET GERMPLASM

S. Ravi[1]*, M. Subba Rao[2], M. Reddi Sekhar[1] and L. Madhavi Latha[2]

[1]Department of Genetics and Plant Breeding, S.V. Agricultural College, Tirupati, A.P.
[2]Department of Genetics and Plant Breeding, ARS, Perumallapalle, Tirupati, A.P.
Email: ravi2raviag@gmail.com

Received-30.09.2015, Revised-11.10.2015

Abstract: The present study aims to reveal the importance of quantitative traits and genetic variability existing in the 76 pearl millet germplasm accessions. The coefficient of variation at phenotypic and genotypic levels were high for root dry weight followed by green fodder yield per plant, root volume , dry fodder yield per plant, grain yield per plant, ear bearing tillers per hill, green fodder yield per plot, dry fodder yield per plot, grain yield per plot, relative injury, leaf area duration, number of grains per ear head, ear head length and plant height and moderate for test weight, harvest index, ear head girth and root spread while the traits, specific leaf area followed by chlorophyll stability index, days to 50% flowering SCMR, leaf temperature and days to maturity showed low PCV and GCV. From the results, high heritability coupled with high genetic advance observed for relative injury, dry fodder yield per plot, ear bearing tillers per hill, dry fodder yield per plant, root volume, grain yield per plant, leaf area duration, root dry weight, green fodder yield per plot, green fodder yield per plant, number of grains per ear head, ear head length, plant height, test weight and grain yield per plot which indicates the preponderance of additive gene effects in controlling these traits, early and simple selection could be exercised due to fixable additive gene effects.

Keywords: Drought, Pearl Millet, Variability, Heritability, Genetic Advance

INTRODUCTION

Pearl millet (*Pennisetum glaucum* L.), 2n= 14, is an outstanding crop being grown in arid and semi-arid regions of the world with the rainfall ranging from 150-700 mm including West Africa, India and Pakistan. India is a major pearl miller producing country with 43.3 per cent of the world area and 42 per cent of world production. It is the warm season cereal crop predominantly grown as a staple food grain and source of feed and fodder under moisture limiting environments. It ranks first under the category of millets in India, in terms of area, production and productivity. India has the largest area of 8.39 million hectares with a production of 9.15 million tones and productivity of 1091 kg ha^{-1} (www.agropedia.com, 2012). Though, it is a drought tolerant crop, it faces moisture stress very often. Hence, breeding for drought tolerance forms an integral part of pearl millet breeding. An understanding of the architecture of the variability and inheritance of target characters is useful for developing effective breeding strategies. The foremost important consideration in any crop breeding programme for its improvement is the detailed study on genetic variability. Knowledge on the nature and magnitude of genotypic and phenotypic variability for yield and yield attributing traits present in any crop species and their heritability, play a vital role in successful selection for evolving superior cultivars. Therefore, an attempt has been made to study the heritability and genetic advance in the present study.

MATERIAL AND METHOD

The genetic material for the present study comprised of 76 advance breeding lines, which were selected and obtained from International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, and Hyderabad. The crop was raised under complete rainfed condition in a randomized block design with two replications during *kharif*, 2012 at Agricultural Research Station, Perumallapalle, Tirupati. All the bajra genotypes were sown initially in the nursery and 3 week old seedlings were transplanted to the main field with a spacing of 45 cm between the rows and 15 cm between plants within a row. Each genotype was planted in 2 rows of 3 m length consisting of 20 plants. Recommended agronomic and cultural measures were followed to raise a good crop. The observations were recorded on five randomly chosen competitive plants in each genotype in each replication for all the 24 characters, except days to 50% flowering and days to maturity. The latter two characters were recorded on per plot basis. The values of five competitive plants were averaged and expressed as a mean of the respective characters. The data were subjected to statistical analysis to estimate Phenotypic and genotypic variances (Lush, 1940), PCV and GCV (Burton, 1952), heritability in broad

*Corresponding Author

sense (Hanson et al., 1956a) and genetic advance (Johnson *et al*., 1955).

RESULT AND DISCUSSION

The analysis of variance revealed highly significant differences among the genotypes for all 24 characters indicating presence of considerable variation in the breeding material under rainfed conditions. The estimates of genetic parameters are presented in Table 1.

Coefficients of Vatriaton

In the present study, the estimates of PCV for all the characters were little higher than the estimates of GCV, which may be due to the interaction of genotypes with the environment. The highest estimate of coefficient of variation was registered for root dry weight followed by green fodder yield per plant, root volume, dry fodder yield per plant, grain yield per plant, ear bearing tillers per hill, green fodder yield per plot, dry fodder yield per plot, grain yield per plot, relative injury, leaf area duration, number of grains per ear head, Ear head length and plant height indicating greater scope of selection for improvement of these characters. Similar results of high estimates of variability were reported by earlier workers for plant height (Lakshmana *et al.*, 2009; Govindaraj *et al.*, 2010; Musa Ishag Mohamed Subi and Atif Elsadig Idris, 2013), ear bearing tillers per hill (Lakshmana *et al.,* 2009), ear head length (Lakshmana *et al.*, 2009; Musa Ishag Mohamed Subi and Atif Elsadig Idris, 2013), number of grains per ear head (Musa Ishag Mohamed Subi and Atif Elsadig Idris, 2013), grain yield per plant (Vidyadhar *et al.*, 2007; Meena Kumari *et al.*, 2008; Lakshmana *et al.*, 2009; Govindaraj *et al.*, 2010), grain yield per plot (Muhammad Hussain Chaudary *et al.*, 2003), green fodder yield (Shanmuganathan *et al*., 2006) and dry fodder yield (Vidyadhar *et al.*, 2007; Veena Priya *et al*., 2010) and corroborates the findings of the present study.

Moderate estimates of coefficients of variation were observed for test weight followed by harvest index (%), ear head girth and root spread. These findings were in concurrence with earlier reports for harvest index. On contrary, low PCV and GCV values were recorded for specific leaf area followed by chlorophyll stability index, days to 50% flowering, SCMR , leaf temperature and days to maturity. Similar kind of low estimates of variability was reported earlier by Sumathi *et al.* (2010) for days to 50% flowering.

Heritability and Genetic Advance

The heritability and genetic advance estimates were interpreted as low, medium and high as per the classification of Johnson *et al.* (1955). Broad sense heritability ranged from 19.99 (chlorophyll stability index) to 96.91 (relative injury) per cent. In general, high heritability estimates in broad sense were registered for almost all the characters under the study except for root spread (22.63%) and chlorophyll stability index (19.99%) which showed low heritability. High heritability coupled with high genetic advance as a per cent of mean were recorded for relative injury, dry fodder yield per plot, ear bearing tillers per hill, dry fodder yield per plant, root volume, grain yield per plant, leaf area duration, root dry weight, green fodder yield per plot, green fodder yield per plant, number of grains per ear head, ear head length, plant height, test weight and grain yield per plot which indicated the inheritance of additive gene effects in the genetic control of these traits. Hence, simple selection can be practiced to improve these traits. This was in conformity with the findings of Govindaraj *et al.* (2011) for ear bearing tillers per hill and Sumathi *et al.* (2010) for ear head length. Further, Meena kumari *et al.* (2008), Govindaraj *et al.* (2010) and Sumathi *et al.* (2010) revealed high estimate of heritability for grain yield per plant.

The knowledge on heritability of traits is helpful to decide the selection procedure to be followed to improve the trait in a situation. High heritability recorded in a trait indicates the low influence of environment on expression of the trait. Therefore, for improving these traits the selection will be more effective in early generation on the basis of *per se* performance of these traits. These traits may be improved by mass or progeny selection. High heritability recorded for grain yield per plant suggested that direct selection based on grain yield *per se* could be effective for its genetic improvement.

High heritability coupled with moderate genetic advance as per cent of mean was recorded for days to 50 per cent flowering, test weight, SPAD chlorophyll reading and specific leaf area. These are more likely to be controlled by both additive and non-additive gene effects. Hence, recurrent selection could be more effective to improve these traits.

Table 1. Mean, coefficients of variation, heritability (broad sense) and genetic advance as per cent of mean for twenty four characters in 76 Pearl millet genotypes

Sl. No.	Character	Mean	Range		Variance		Coefficient of Variation		Heritability (Broad sense) (%)	Genetic advance (GA)	Genetic Advance as per cent of mean (%)
			Max.	Min.	Genotypic	Phenotypic	Genotypic	Phenotypic			
1.	Days to 50% flowering	64.08	77.50	51.00	24.02	28.43	7.65	8.32	84.49	9.28	14.48
2.	Days to maturity	98.98	104.50	92.50	4.07	7.92	2.04	2.84	51.43	2.98	3.01
3.	Plant height (cm)	149.96	205.65	65.23	691.24	952.50	17.53	20.58	72.57	46.14	30.77
4.	Ear bearing tillers per hill	1.83	4.20	0.65	0.57	0.61	41.29	42.73	93.38	1.50	82.19
5.	Ear head length (cm)	27.75	42.00	15.88	31.90	42.22	20.35	23.42	75.55	10.11	36.44
6.	Ear head girth (cm)	2.78	3.54	2.04	0.07	0.12	9.38	12.40	57.18	0.41	14.61
7.	Test weight (g)	10.91	14.50	5.18	2.64	3.59	14.90	17.35	73.70	2.88	26.35
8.	Number of grains per ear head	2852.15	4524.50	810.35	582152.20	724686.40	26.75	29.85	80.33	1408.73	49.39
9.	Grain yield per plant (g)	298.04	650.75	92.55	208799.80	248875.40	35.02	37.90	85.38	198.66	66.66
10.	Green fodder yield per plant (g)	1127.37	2377.50	335.00	11686.67	12652.29	40.53	44.25	83.90	862.20	76.48
11.	Dry fodder yield per plant (g)	260.71	591.50	84.90	0.56	0.85	41.47	43.15	92.37	214.03	82.10
12.	Grain yield per plot (t/ha)	2.93	0.97	5.60	3.11	3.62	25.44	31.51	65.16	1.24	42.30
13.	Green fodder yield per plot (t/ha)	5.12	3.63	7.90	0.86	0.90	34.42	37.17	85.77	3.36	65.67
14.	Dry fodder yield per plot (t/ha)	2.57	1.71	3.04	22.78	58.70	36.21	36.94	96.05	1.88	73.10
15.	Harvest index (%)	53.39	64.48	39.49	0.48	1.47	8.94	14.35	38.81	6.12	11.47
16.	Leaf temperature (^{o}C)	31.27	33.67	29.50	17.59	18.27	2.21	3.88	32.43	0.81	2.59
17.	SCMR	56.87	67.25	48.10	132.05	193.96	7.37	7.52	96.25	8.48	14.90
18.	Specific leaf area (cm^2g^{-1})	153.87	211.30	128.43	45.16	46.60	7.47	9.05	68.08	19.53	12.69
19.	Relative Injury	19.99	42.62	9.66	11.18	55.91	33.61	34.14	96.91	13.63	68.15
20.	Chlorophyll Stability Index	76.18	88.89	63.42	4.79	5.27	4.39	9.82	19.99	3.08	4.04
21.	Leaf area duration (cm^2day^{-1})	7.53	12.46	2.55	3.58	15.81	29.05	30.50	90.76	4.29	57.02
22.	Root spread (cm)	30.67	39.45	23.84	40.03	45.04	6.17	12.96	22.63	1.85	6.04
23.	Root dry weight (g)	14.86	34.68	3.97	190.51	210.89	42.56	45.15	88.88	12.29	82.66
24.	Root volume (ml)	33.03	72.50	11.50	10892.90	12758.25	41.79	43.97	90.34	27.02	81.83

CONCLUSIONS

Based on results of this study, it could be concluded that there was considerable amount of variability present in the genotypes. To sum up, higher GCV, heritability and genetic advance as per cent of mean were observed for root dry weight, root volume, dry fodder yield per plant, green fodder yield per plot, relative injury, leaf area duration, number of grains/ ear head, grain yield per plot and ear head length indicating that simple directional selection could be effective for improving these traits as additive gene effects were predominantly inherent in these traits. Conversely, low estimates of GCV, heritability and genetic advance as per cent of mean were registered for root spread, chlorophyll stability index and leaf temperature indicating little scope of improvement of these traits by selection as they are governed by the non-additive gene effects.

REFERENCES

Burton, G.W. (1952). Quantitative inheritance in grasses. *Proceedings of Sixth International Grassland Congress,* **1**: 277-283.

Govindaraj, M.; Shanmugasundaram, P. and Muthiah, A.R. (2010). Estimates of genetic parameters for yield and yield attributes in elite lines and popular cultivars of India's pearl millet. *African Journal of Agricultural Research,* **5**(22): 3060-3064.

Hanson, G.H.; Robinson, H.F. and Comstock, R.E. (1956). Biometrical studies of yield in segregating populations of Korean Lespedeza. *Agronomy Journal*, **8**:267-282.

Harinarayana, G.; Anand Kumar, K. and Andres, D.J. (1999). Pearl millet in Global Agriculture. Publishing Co., Pvt. Ltd., New Delhi, India. pp: 479-506.

Johnson, H.W.; Robinson, H.F. and Comstock, R.E. (1955a). Estimation of genetic and environmental variability in soybean. *Agronomy Journal*, **47**: 314-318.

Lakshmana, D.; Biradar, B.D. and Ravi Kumar, R.L. (2009). Genetic variability studies for quantitative traits in a pool of restorers and maintainers lines of pearl millet (*Pennisetum glaucum* (L.). *Karnataka Journal of Agricultural Science*, **22** (4): 881-882.

Lush, J.L. (1940). Intra-sire correlation and regression of offspring in rams as a method of estimating heritability of characters. *Proceedings of American Society of Animal Production*, **33**: 292-301.

Meena Kumari, B. and Nagarajan, P. (2008). Variability and Heritability analysis in pearl millet (*Penisetum glaucum* [L.] R. Br.). *Madras Agricultural Journal.* **9**5 (1-6):190-192.

Muhammad Hussain Chaudary.; Ghulam Mahaboob Subhani.; Muhammad Saleem Shaheen. and Usman Saleem (2003). Correlation and path coeffients analysis in pearl millet (*Pennisetum americanum* L.). *Pakistan Journal of Biological Sciences,* **6** (6): 597-600.

Musa Ishag Mohamed Subi and Atif Elsadig Idris (2013). Genetic Variability, Heritability and Genetic Advance in Pearl Millet (*Pennisetum glaucum* [L.] R. Br.) Genotypes. *British Biotechnology Journal*, **3**(1): 54-65.

Shanmuganathan, M.; Gopalan, A. and Mohanraj, K. (2006). Genetic variability and multivariate analysis in pearl millet (*Pennisetum glaucum* (L.) R. Br.) germplasm for dual purpose. *The Journal of Agricultural Sciences*, **2**(1): 73-80.

Sumathi, P.; Sumanth Madineni. and Veerabadhiran, P. (2010). Genetic Variability for Different Biometrical Traits in Pearl Millet Genotypes (Pennisetum glaucum L. R. Br.). *Electronic Journal of Plant Breeding*, **1**(4): 437-440.

Veena Priya, K.V.; Kumari, R.U.; Suguna, R. and Usharani, K.S. (2010). Studies on genetic distance between the diverse germplasm in pearl millet for fodder characters (*Pennisetum glaucum* (L.) R. Br.). *Electronic Journal of Plant Breeding*, **1**(4): 1035-1041.

Vidyadhar, B.; Pooran chand.; Swarnalatha devi, I.; Vijaya sai reddy, M. and Ramachandraiah, D. (2007). Genetic variability and character association in pearl millet {*Pennisetum glaucum* (L.) R. Br.} and their implications in selection. *Indian Jurnal of Agriculture Researh,* **41** (2): 150-153.

IMPACT OF DIFFERENT ORGANIC MANURES ON YIELD PARAMETERS OF WATERMELON [*CITRULLUS LANATUS* (THUMBS) MANSF.] CV. 'SUGAR BABY' UNDER NORTH GUJARAT CONDITION

Parthiv K. Parmar[1], Prashant B. Sandipan*[2], V.D. Maheriya[3], M.K. Parmar[4] and K.N. Makwana[5]

[1, 4 & 5] C. P. C. A., SDAU, Dantiwada, Banaskantha
[2 & 3] Main Cotton Research Station, NAU, Surat – 395 007, Gujarat
E-mail: prashantsandipan@gmail.com

Received-01.09.2015, Revised-08.09.2015

Abstract: Watermelon [*Citrullus lanatus*] is a cucurbitaceous crop and is green vegetable, but in the ripe stage as refreshing fruit. Application of recommended dose of FYM @ 20 t/ha + NPK (100-50-50 kg NPK/ha) recorded the maximum fruit diameter (39.95 cm) which was followed by treatment of 100 % N of recommended dose in form of vermicompost (37.76 cm). While, the superior treatment gave highest Number of fruits per vine (3.38), Fruit weight/kg (3.19), Yield per vine kg (10.78) and Yield per ha (53.91).

Keywords: Watermelon, *Citrullus lanatus*, Neem cake, Vermicompost, FYM, Castor cake, Poultry manure

INTRODUCTION

Watermelon [*Citrullus lanatus* (Thumbs) Mansf.] is a cucurbitaceous crop, believed to be the native of Africa (Thompson and Kelley, 1957). Watermelon is green vegetable, but in the ripe stage as refreshing fruit. It cultivated in all parts of India. The important watermelon growing states are Madhya Pradesh, Rajasthan, Punjab and Maharashtra. In Gujarat, generally it is grown as riverbed crop in the sandy belts of Purna, Narmada, Tapi and other rivers. Watermelon is generally grown for its juicy flesh, which is sweeter in taste. The raw fruits can be used for vegetable pickling and candy making. The juice is also fermented and concentrated into sugar syrup, which is used in western countries for making beverages. According to Bose and Som (1986) the nutritive value of watermelon is as follows per 100 g of edible portion. Edible portion 78.00 per cent, water 95.89 per cent**,** calcium 11.00 mg, phosphorus 12.00 mg, iron 7.9 mg, thiamine 0.02 mg, riboflavin 0.04 mg, fibre 0.2 g, niacin 0.1 mg, carbohydrates 3.3 g, vitamin 1 mg, protein 0.2 g, fat 0.2 g, minerals 0.3 g and energy 16 K Cal. The watermelon is a summer crop. Hence, it is usually sown in the month of January and February in Gujarat state. The success of Indian Agriculture depends heavily on use of fertilizer and other modern inputs. Nutrients play an important role in improving productivity and quality of watermelon. Nitrogen increase plant height, assimilating area, size of fruits *etc*. Phosphorus is an equally essential nutrient as a constituent of nucleo-proteins, enzymes and high energy bonds, while, the potassium improves the quality of fruits with good keeping quality. The judicious use of chemical fertilizers increases the quality and quantity.

Nitrogen from castor cake becomes quickly available to plants because of decomposition of castor cake is faster than other bulky organic manures to low C: N ratio and it nitrifies quickly (Guar *et al.,* 1984). Castor cake is one of the important sources of organic manures. It contains 4.27 per cent N_2, 1.85 per cent P_2O_5 and 1.5 per cent K_2O along with a large quantity of organic matter (Patel *et al.,* 1992). Use of FYM increases soil organic matter content and have a greater residual effect than mineral fertilizers. FYM supplies all the essential nutrients, which improve the physico-chemical properties, water holding capacity and encourages the soil microbial activities. FYM is also advantageous for its residual value. It contains 0.75 per cent N_2, 0.20 per cent P_2O_5 and 0.50 per cent K_2O. Moreover in this experiment, vermicompost is adopted as organic manure produced by use of earth worms. It modifies soil physical, chemical and biochemical properties. It contains 3.0 per cent N_2, 1.0 per cent P_2O_5 and 1.5 per cent K_2O.

Neem cake is quick acting concentrated organic manures. Generally, neem cake contains 5.0 to 6.0 per cent N_2, 1.0 to 1.5 per cent P_2O_5 and 1.0 to 2.0 per cent K_2O. Keeping in view, the above facts, the present experiment was laid down in terms of growth and yield parameters of the watermelon crop.

MATERIAL AND METHOD

Location

The experiment was laid in SDAU University which is situated on 24^o 19' N latitude and 72^{o}E longitudes with an elevation of 154.52 meters above the sea level. It represents the North Gujarat Agro-climatic Zones, Sardarkrushinagar is situated 27 kms away from Palanpur.

*Corresponding Author

Climatic and Weather Conditions

The climate of Sardarkrushinagar is typically sub-tropical characterized by semi-arid and arid conditions having warm and humid monsoon, cool and dry winter and quite hot and dry summer. The rainfall is received from the month of June to September. In order to get an idea about the climatic conditions, an average weekly data on different weather parameter factors during the period of experimentation were obtained from the Agricultural Meteorological Observatory located at the Agronomy Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar.

Choice of Variety

The watermelon variety 'Sugar Baby' was selected for the present study because, it is suitable for summer planting. Fruits are round and yellowish green in colour gives high yields and hence preferred by the growers. The seeds were obtained from National Seeds Corporation, Ahmedabad.

Fertilizer Application

For one hectare, 20 tonnes of FYM is required. The chemical fertilizer 100 kg N_2, 50 kg P_2O_5, 50 kg K_2O and the different organic manures like castor cake, vermicompost, neem cake and poultry manure and were applied in pit as per the requirement of different treatments.

Seed Sowing

The seed sowing was done by dibbling method with the three seeds per hill, at a depth of 2 – 3 cm in the rows, which was prepared before sowing. The inter row spacing of 2.0 m and intra row spacing of 1.0 m was maintained. After germination, the thinning was done so as to keep only one vigorously growing seedling per hill.

Experimental Details

The details of the experiment are as under:

1.	Experimental Detail			
	[A]	Treatments	:	7 (Seven)
	[B]	Treatments details	:	
		T_1 :	100 % N of recommended dose in form of FYM	
		T_2 :	100 % N of recommended dose in form of castor cake	
		T_3 :	100 % N of recommended dose in form of vermicompost	
		T_4 :	100 % N of recommended dose in form of Neem cake	
		T_5 :	100 % N of recommended dose in form of poultry manure	
		T_6 :	Recommended dose of FYM @ 20 t/ha + NPK (100-50-50 kg NPK/ha)	
		T_7 :	NPK (100-50-50 kg NPK/ha)	
	[C]	Design	:	Randomized Block Design (RBD)
	[D]	Replications	:	4 (Four)
	[E]	Crops and variety	:	Watermelon Cv. "Sugar Baby"
	[F]	Seed rate	:	3 – 4 kg ha^{-1}
	[G]	Planting distance	:	2.0 m X 1.0 m
	[H]	Number of rows per plot	:	2
	[I]	Number of plant per plot	:	8
	[J]	Total number of plots	:	28
	[K]	Total area under experiment	:	560 sq.m.
	[L]	Size of plot	:	4.00 m x 4.00 m
	[M]	Soil	:	Sandy loam

Preparation of Material

Well decomposed organic manures like FYM, castor cake, vermicompost, neem cake, poultry manure and recommended dose of fertilizer were selected. According to the requirement of each treatment, the required quantity of material was weighted separately. The total quantity required for the experiment was FYM (182 kg), castor cake (14.64 kg), vermicompost (21.32 kg), neem cake (12.26 kg), poultry manure (21.12 kg), chemical fertilizer, Diammonium phosphate (1.5 kg), Ammonium sulphate (5.0 kg) and Murate of Potash (1.06 kg).

RESULT AND DISCUSSION

Fruit Character

Average diameter of fruit (cm)

A perusal of the data indicated that the differences in the diameter of fruits were found to be significant. Maximum diameter of fruit was recorded in treatment of recommended dose of FYM @ 20 t/ha + NPK 100-50-50 kg NPK/ha (39.95 cm) followed by treatment of 100 % N of recommended dose in form of vermicompost (37.76 cm) and both were at par.

Minimum diameter of fruit was recorded in the treatment of 100 % N of recommended dose in form of Neem cake (23.84 cm) (Table: 1).

Yield Character

Number of fruits per vine

From the data (Table: 1), it is seen that the differences in the number of fruits per vine arising due to different treatments were significant. The data show that all the treatments were significant.

A perusal of the data revealed that the highest number of fruits per vine was recorded in treatment of recommended dose of FYM @ 20 t/ha + NPK (100-50-50 kg NPK/ha) (3.38) followed by treatment of 100 % N of recommended dose in form of vermicompost (3.00), which were at par. The lowest number of fruits per vine (2.44) was obtained in the treatment of 100 % N of recommended dose in form of Neem cake.

Average fruit weight (kg)

It is quite apparent from the data (Table: 1) that fruit weight was significantly increased with all the treatments. Maximum fruit weight was recorded in treatment of recommended dose of FYM @ 20 t/ha + NPK (100-50-50 kg NPK/ha) (3.19 kg) followed by treatment of 100 % N of recommended dose in form of vermicompost (3.14 kg), which were at par. Minimum fruit weight was observed in treatment of 100 % N of recommended dose in form of Neem cake (2.01 kg).

Fruit yield per vine (kg)

From the data (Table: 1), it is seen that the differences in the fruit yield per vine arising due to different treatments were significant. A perusal of the data revealed that the highest yield per vine was recorded in treatment of recommended dose of FYM @ 20 t/ha + NPK (100-50-50 kg NPK/ha) (10.78 kg) followed by treatment of 100 % N of recommended dose in form of vermicompost (9.42 kg). The lowest fruit yield per vine was obtained in the treatment of 100 % N of recommended dose in form of Neem cake (4.90 kg).

Fruit yield (t/ha)

It is clearly seen from the data (Table: 1) that the differences in the fruit yield per hectare arising due to different treatment were significant. The treatment recommended dose of FYM @ 20 t/ha + NPK (100-50-50 kg NPK/ha) had the highest yield (53.91 t/ha) and the treatment of 100 % N of recommended dose in form of Neem cake had the lowest yield (24.52 t/ha).

Thus, from the point of view of yield, the treatment recommended dose of FYM @ 20 t/ha + NPK (100-50-50 kg NPK/ha) was found to be effective in increasing the yield as compared to the other treatments. The above findings are in agreement with the findings of Tuzel et al. (2003) conducted an experiment under greenhouse conditions for organic cucumber (Cv. Sardes) production using two irrigation levels (30 and 50 cb soil water tensions) and four organic fertilizers (30 t FYM ha-1 + E 2001 + Allgrow Bioplasma; 50 t FYM ha-1; 30 t chicken manure ha-1 + E 2001 + Allgrow Bioplasma and 50 t FYM ha-1). They observed that farm yard manure and chicken manure + E 2001 + Allgrow Bioplasma applied under 50 cb of soil water tension had the highest yield. Chaudhary *et al*., (2004) studied that organic waste returned to the soil can maintain, enhanced soil quality, fertility, productivity through favourable effect on soil properties and other processes. Vermicompost technology for composting of organic waste remarkable effective for reduction in processing time of decomposition and produce good quality compost in terms of nutrient. Agu (2004) observed that application of poultry manure @ 20 t ha-1 significantly increased the growth and yield of pumpkin above the control. A maximum yield of pumpkin fruits was also obtained with application 20 tonne poultry manure per hectare and Umamaheswarappa (2002) suggested that application of 120 kg N ha-1 + 100 kg P ha-1 + 30 kg K ha-1 with FYM recorded the highest yield and appeared to be optimum for bottlegourd Cv. Arka Bahar production in the southern dry region of Karnataka.

Table 1. Effect of various organic manures on yield components of watermelon crop

Treatments		Fruit diameter cm	Number of fruits per vine	Fruit weight kg	Yield per vine	Yield per hectare (t)
T_1	100 % N of recommended dose in form of FYM	32.52	2.94	2.91	8.56	42.77
T_2	100 % N of recommended dose in form of castor cake	28.76	2.69	2.68	7.21	36.04
T_3	100 % N of recommended dose in form of vermicompost	37.76	3.00	3.14	9.42	47.1
T_4	100 % N of recommended dose in form of Neem cake	23.84	2.44	2.01	4.9	24.52

T_5	100 % N of recommended dose in form of poultry manure	25.75	2.68	2.2	5.92	29.59
T_6	Recommended dose of FYM @ 20 t/ha + NPK (100-50-50 kg NPK/ha)	39.95	3.38	3.19	10.78	53.91
T_7	NPK (100-50-50 kg NPK/ha)	29.05	2.75	2.88	7.92	39.6
	S.Em. ±	0.955	0.14	0.07	0.21	0.56
	C.D. at 5 %	2.838	0.41	0.2	0.63	1.65
	C.V. %	9.326	14.83	7.52	8.12	4.26

REFERENCES

Agu, C.M. (2004). Growth and yield responses of pumpkin (*Cucurbita maxima*) to poultry manure application and staking techniques in Southeastern Nigeria. *J. Sustainable Agriculture.* **24** (2): 5-10.

Bose, T.K. and Som, M.G. (1986). Vegetable crops in India. Publ. Naya Prokash, Calcutta.

Chaudhary, D.R., Bhandari, S.C. and Sukla, L.M. (2004). Role of Vermicompost in Sustainable Agriculture. *A Review Agric. Rev.,* **25** (1): 29-39.

Gaur, A.C., Neelakantan, S. and Dargan, K.S. (1984). "Organic manures" Indian Council of Agricultural Research, New Delhi. p.38.

Patel, B.A., Patel, R.H., Patel, M.V. and Amin, A.U. (1992). Effect of combined application of organic sources and inorganic fertilizers on wheat. *Indian J. Agron.,* **37** (1): 52-54.

Thompson and Kelly (1957). Cultivation aspects of cucurbitaceous. *Crops Sci. Hort.,* **2**: 41-50.

Tuzel, Y., Gul, A., Tuzel, I.H., Ongun, A.R. and Abou-Hadid, A.F. (2003). Organic cucumber production under greenhouse conditions. *Acta Horticulturae.* **608**: 149-157.

Umamaheswarappa, P., Krisnappa, K.S., Muthu, M.P., Gowda, V.N. and Murthy, P.V. (2002). Flowering, fruit set, fruit size and yield of bottle gourd in relation to varying levels of N, P and K in Southern dry region of Karnataka.

CONSTRAINTS IN ADOPTION OF IMPROVED TOMATO PRODUCTION TECHNOLOGY

Biseshwar Sxena[1] and S. Narbaria*[2]

Department of Agricultural Extension, Collage of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur – 492012 (C.G.), India
Email: sunilag22@gmail.com

Received-10.10.2015, Revised-22.10.2015

Abstract: Adoption of any production technology depends on the availability of the essential resources. The present investigation was carried out in the six purposively selected villages of Pathalogon Block of Jashpur district. Seventy two respondents were selected randomly and personally interviewed with the help of the structured interview schedule. The study revealed that the all the seventy two tomato growing farmers (100 %) reported that they were not getting desired price for their produce and 86.11 per cent respondent highlighted the lack of transportation facilities. The same percentage of the respondents (86.11 %) also encountered with the problem of non-availability and unreliable cost of fertilizers. 77.77 and 52.77 per cent respondents reported the problems like non-availability of information related to improved tomato production technology at the right andd non-availability of insecticides & fungicides respectively. Whereas only 27 tomato growing farmers were (37.5 %) reported lack of capital as constraints.

Keywords: Tomato Cultivation, Adoption, Constraints and improved production practices

INTRODUCTION

Vegetables not only provide maximum output but also give more income per unit area of land. Vegetable cultivation among small land holders has always been source of supplementary income and provides gainful employment through intensive cultivation and thus vegetable growers are normally more prosperous than those who grow cereals, because of higher return. The Jashpur district in Chhattisgarh State is famous for tomato production, in spite of having totally rainfed area. The tomato crop covers an area of 2577 hectare and production is 51560 tones as recorded by the Horticulture department of Raigarh (1996-1997). In order to increase the production of tomato crop, several improved varieties have been released during the recent years. Concentrated work has been undertaken by the govt. officials / extension personnel to promote adoption of improved cultivation practices of tomato crop. Scientist / Researcher advocate the use of package of tomato production technology with which the farmers have to be convinced, so that they can adopt the improved technologies in their farming system. If scientific methods are followed it gives almost 300-q/ha yield in open pollinated varieties and upto 880 qui/ha in case of hybrids (www.cgagridept.in).

MATERIAL AND METHOD

Location of the study

The study was conducted in the Jaspur district of the Chhattisgarh state. The Chhattisgarh state consists of 27 districts, out of which Jaspur district was selected because the maximum area of tomato cultivation quite high among all the districts of Chhattisgarh state. Out of 8 blocks of Jashpur district, only Pathalgaon block was selected purposively for the study because it has the largest area under tomato cultivation in comparison to other blocks in the district. The Pathalgaon block has a total number of 110 villages, out of which thirty villages having highest area and production under tomato crop. Out of these villages, six villages namely Bildegi, Bandhanpur, Birindega, Ludig, Mudapara, Saraitola selected using SRSWOR (Simple Random Sampling without Replacement) technique for the study.

Method of data collection

A list of the tomato growers of the selected villages was prepared. The name of the tomato growers were arranged alphabetically and twelve tomato growers from each selected village were selected on random basis. Thus, seventy-two respondents were finally selected for the purpose of conducting this study. The data were collected with the help of well structured and pre-tested and well structured interview schedule.

RESULT AND DISCUSSION

Constraints faced by the respondents during the adoption of recommended tomato production technology

During the course of interview the respondents were asked about the constraints as they felt in adoption of recommended tomato production technology. As per the responses given by the respondents shown in table 4.4.1 reveal that all the seventy two tomato growing farmers (100 %) reported that they were not getting desired price for their produce and 86.11 per cent respondent highlighted the lack of transportation facilities. The same percentage of the respondents

*Corresponding Author

(86.11 %) also encountered with the problem of non-availability and unreliable cost of fertilizers. 77.77 and 52.77 per cent respondents reported the problems like non-availability of information related to improved tomato production technology at the right time and non-availability of insecticides & fungicides respectively. Whereas only 27 tomato growing farmers (37.5 %) reported that lack of capital as a constraints. Aswathaiah (1972), Kushwaha (1996) also noted almost similar findings.

Table 1. Distribution of the respondents according to their constraints as faced by them during the adoption of tomato production technology

Problem expressed by the farmers	Frequency	Percentage	Rank
Not getting appropriate price of produce	72	100	I
Non availability of information related to improved tomato production technology at the right time	56	77.77	III
Lack of transportation facilities	62	86.11	III
Lack of capital	27	37.5	IV
Non- availability of insecticide and fungicides	38	52.77	IV
Non availability and unreliable cost of fertilizers	62	86.11	III
Lack of soil testing facility	49	68.05	II

*Data are based on the multiple responses

Suggestions as given by the respondents regarding tomato production technology

The respondents were asked to submit their cognitive suggestions that can overcome their constraints in the adoption of recommended tomato production technology and shown in table 2. The table shows that proper marketing facilities scored the highest value i.e. 95.83 per cent followed by 94.44 per cent respondents suggested that organizing training camp at village level on the tomato production technology will help them in increasing their knowledge as well as skill related to the tomato production. 87.50 % respondents suggested the installation of value addition processing unit at block level by government, 79.17 per cent respondents said that transportation facilities, 70.83 per cent respondents viewed that availability of modern agriculture information and 65.27 per cent respondents suggested that efforts should be made to provide fertilizer on appropriate rate also will help them to overcome the constraints. While 59.72 per cent respondents suggested that credit facility should be made available at proper time with low interest rate, 58.33 per cent respondents suggested soil testing facilities at block level and 48.61 per cent respondents was of view that availability of plant protection chemicals also would be useful remedial measure to overcome the constraints faced by them during the adoption of recommended tomato production technology.

Table 2. Distribution of the respondents according to their suggestions as given by the respondents for improving the adoption level of tomato production technology

Suggestions	Frequency	Percentage	Rank
Proper marketing facilities should be available	69	95.83	I
Efforts should be made for establishing value addition processing unit at least at the block level by the government	63	87.50	III
Modern agricultural information should be easily available	51	70.83	V
Training camp at village level should be organized on tomato production technology	68	94.44	II
Proper transportation facilities should be created	57	79.17	IV
Credit facilities should be provided at proper time with low interest rate	43	59.72	VIII
Provision should be made for easy availability of plant protection chemicals	35	48.61	IX
Efforts should be made for providing fertilizers on appropriate rate	47	65.27	VI
Soil testing facility should be made available at block level	42	58.33	VII

Factors associated with adoption of improved tomato production technology

To determine the relationship between independent variables and extent of adoption of the farmers, the correlation analysis was done and results are presented in Table3.

Table 3. Correlation and multiple regression analysis of independent variables with the extent of knowledge about tomato production technology

Variables	Coefficient of correlation "r" value	Partial regression coefficient	
		"b" value	"t" value
XI Age	0.7897**	0.186	0.978
X2 Education	0.1578	0.603	1.454
X3 Caste	-0.0523	-1.088*	2.150
X4 Size of family	0.3005**	-0.176	0.896
X5 Land holding	0.0716	-0.062	0.777
X6 Experience of farmers	0.7421**	0.468	1.862
X7 Annual income	0.0493	0.000	0.176
X8 Economic motivation	0.6991**	0.289	0.363
X9 extension contact	0.1120	-0.457	2.259*
XI0 Source of information	0.7120**	0.280	0.682

* Significant at 0.05 level of probability multiple $R^2 = 0.6336$

** Significant at 0.01 level of probability F-Value = 9.43 (with 10 and 60 d.f.)

To determine the relationship between independent variables and extent of adoption of the farmers, the correlation analysis was done and results are presented in Table3. Out of ten independent variables, only five variables like age, size of family, experience of farmer, economic motivation and sources of information were found to be positive and highly significant as they were correlated at 0.01 per cent level of probability with the adoption of tomato production technology. Remaining five variables did not indicate any significant relationship with adoption of tomato production technology. Multiple regression analysis was also applied to determine the prediction ability and contribution of independent variables in extent of adoption of the farmers about tomato production technology. Out of selected ten independent variables in the analysis, only extension contact showed the significant effect on adoption of tomato production technology. Corresponding F-value (11.86) for the model was found significant at 0.05 level of probability. Therefore it is suggested that for increasing the adoption of tomato production technology, efforts should be taken for timely personal contact with the tomato growing farmers. Almost similar result was also reported by Kushwaha (1996), Shrivastava (2001) and Rajgopal (1975) also found similar findings.

REFERENCES

Aswathaiah, B., Krishna, K. S., Siddaramaiah, B. S. (1972). A study of the extent of adoption of improved practices in respect of chilli cultivation. Farm Journal, 12, No. 12.

Kushwaha, P. L. (1996). Adoption behaviour in relation to economics of tomato production in Maihar block of Satna district, Mahdya Pradesh. M. Sc. (Ag.) thesis College of agriculture, JNKVV, Jabalpur.

Gopalakrishna, C. (1972). A study on the adoption of recommended potato practices by farmers of Hoskote taluk, Bangalore District. M. Sc. thesis (unpublished), University of Agricultural Sciences, Bangalore..

Rajgopal (1975). Plant protection practices and problems of vegetable growers in Bangalore district, Directorate of extension UAS. Mysore J. of Agric. Economics. 9:499-509.

Shrivatava, K.K., Patel, H.L., Lakhera, M.L., Awasthi, H.K. and Singh, P.R. (2001). Knowledge level of farmers about chilli production technology. Abstract published in workshop cum seminar on sustainable agriculture for 21st Century, held at IGAU, Raipur on Jan, 20-21, 2001, **pp30.** **www.cgagridept.in**

A CASE STUDY OF HEAVY METALS OF BAGAD RIVER FROM GAJRAULA

Pravesh Kumar*

P.G. Department of Zoology,
J. S. Hindu (P.G.) College, Amroha, U.P., INDIA
Email: pksainiamr@gmail.com

Received-13.10.2015, Revised-25.10.2015

Abstract: The aim of this study is to determine heavy metals in contaminant drinking water of Bagad river (A tributary of Ganga). It is a micro level study of Gajraula town of Amroha district of U. P. which will be useful in studying and understanding impact of water pollution on human, residing in any region of the country in terms of health status. The chemistry of drinking water commonly has been cited as an important factor in many diseases. Metal extraction is an important industry for our modern way of life. However, all phases in the life of a mine can discharge metals to rivers, estuaries, streams and lakes. Metal dissolve in water and are easily absorbed by fish and other aquatic organisms. Small concentration can be toxic because metals undergo bio-concentration, which means that their concentration is an organism is higher than in water, metal toxicity produces adverse biological effects on an organism's survival. Metal can be lethal or harm the organism without killing it directly. Adverse effects on an organism is activity, growth, metabolism and reproduction are examples of sub lethal effects. These diseases are apparently related to contaminant drinking water with heavy metals such as Zn, Hg, Cd, Cu, Ni, and Cr. Renal failure is related to contamination drinking water with lead and cadmium, liver cirrhosis to copper and molybdenum, hair loss to nickel and chromium, and chronic anemia to copper and cadmium.

Keywords: Heavy metals, Water, River, Ganga

INTRODUCTION

Natural water contains different concentrations of metals. Some of the different states are soluble in water while other exists in the solid phase. The total concentration of metals in any natural water is the summation of soluble metals and insoluble metals or metals bound to colloids (Drever, 1997). Generally, trace amount of metals are always present in freshwaters from the weathering of minerals and soils. In addition, particularly in developed countries, industrial wastewater discharges are the major source of metals pollution in fresh water. The metals accumulation in an environment has direct impact to human and to the ecosystem. Significant amount of metals are also to enter surface water from sewage and atmospheric deposition. Some metals, including cobalt, copper, zinc, iron, manganese, molybdenum and vanadium present in trace concentrations are important for the physiological functions of living tissue. However, any excessive levels of essential metals can be detrimental to the living organism. The heavy metals, of particular concern to surface water systems are non essential elements like cadmium, mercury, lead, arsenic and antimony (Kennish, 1992). The accumulation of metals due to long term exposure may progressively lead to more severe disruption in the normal functioning of the organic system. Contamination of heavy metals in the environment is of high concern because of their toxicity and threat to human life and environment (Purves, 1985 and Ma and Rao, 1997). The extent to which a non-biodegradable metal becomes toxic depends upon the amount and the form in which they occur and undergo a global biogeochemical cycle in which natural waters are the main pathways (Nurnberg, 1984). Cook *et al.*, (1990) and Deniseger *et al.*, (1990) have reported the heavy metal residues in contaminated habitats may accumulate in micro-organisms, aquatic flora and fauna, which, in turn may enter in to the human food chain and result in health problems.

MATERIAL AND METHOD

The study was conducted from January 2010 to December 2011 in Gajraula industrial area. Gajraula is an important industrial town in Amroha district of the northern state of India, Uttar Pradesh. Gajraula is an industrial area and located near the Bagad River. Gajraula industrial area was selected on the basis of existence large number of industries like chemical units, pulp and paper, single super phosphate plant, pharmaceuticals, dairy product processing and others. The field area comprised of water collection of the river was done from the bank of river Bagad. Bagad River severely contains treated or untreated effluents in composite from of all the industries of Gajraula industrial area. The samples were collected from the Bagad River to assess the heavy metals. Water samples were collected from five sampling stations namely, Shabazpur dor, Naipura Khadar, Tigaria Bhur, Sultanpur Dhar and Soharka. The river samples were collected from two points: (a) from the bank, and (b) from the middle of the river. Water samples were collected in the months of February (winter), May (Pre-monsoon), August (monsoon) and October (post-monsoon) during January 2010 to December 2011. All the samples were taken in new white 125 ml high-density polypropylene (HDP) pre-

*Corresponding Author

cleaned bottles. Before sampling, sample bottles were cleaned by soaking with 10% nitric acid for 24 hours and then thoroughly washed with double distilled water and followed by mil-Q water. Subsequently, all the bottles were dried in oven at 50^0C for 6 hours. Water samples were collected from 5-10 cm below the river surface water. Concentrations of the trace elements (Cr, Mn, Fe, Co, Ni, Cu, Zn, Cd and Pb) were measured by using Atomic Absorption Spectrophotometer. First the instrument was calibrated by using known concentration of metal sample and a standard curve was drawn. Total mercury concentration in unfiltered water sample (100 ml) was determined by cold vapor technique according to the standard method (APHA and AWWA, 1998).

RESULT AND DISCUSSION

The data are listed in Tables 1&2 that contain concentration of heavy metals in MgL^{-1} in different sample locations of Bagad River. In fresh water, Ni concentration ranges from 0.001 to 0.003 mg/l (Scoulolous and Hatzianestis, 1989) and also increases where Ni-containing ores reach surface water. Nickel is one of the most mobile heavy metal in the aquatic environment. The mobility of Nickel in the aquatic environment is controlled largely by the capability of various sorbets to scavenge it from the aquatic solution. In the present study, Nickel values ranged between 2.23 mg/l to 3.42 mg/l. The maximum concentration of Ni 3.42 mg/l was recorded in August 2010 at Soharka. The minimum concentration 2.23 mg/l observed in the month of February 2010 at Shabazpur Dor.

Copper is an essential micro-nutrient in many enzymatic reactions in mammals. In fresh water, most inorganic Cu in solution is present as complexes with carbonate, nitrate, sulphate and chloride, rather than hydrated divalent cupric ion. In fresh water, more than 90% of total Cu may be bound to humid substances. The mobility and bio-availability of metal species in aquatic systems are very depending on their physico-chemical forms, especially their reactivity. The copper valued varied from 2.13 mg/l to 3.81 mg/l. The maximum value of 3.81 mg/l was recorded at Naipura Khadar in the month of February 2011. The minimum value of 2.13 mg/l was observed at Shabazpur Dor in the month of May 2010.

Zinc is an essential element, necessary for sustaining all life and shows toxic effects only at very high concentration. Deficiency of zinc leads to retardation of growth, dehydration, electrolyte imbalance, abdominal pain and dizziness (Jain *et al.,* 2004). Industries and agriculture are the major contributors for increase in the concentration of zinc in river water. It produces an undesirable taste to the drinking water. The concentration of Zn in river water varies with flow as well as in the sediment accumulation. Zinc concentration varied from 1.16 mg/l to 3.82 mg/l in this present study. The maximum concentration of zinc 3.82 mg/l was recorded in October 2011 at Naipura Khadar. The minimum concentration of zinc 1.16 mg/l was recorded in May 2010 (Pre- monsoon) at Shabazpur Dor.

Table 1. Heavy Metals of River Bagad at Selected Sampling Stations in Year 2010.

Sampling Station		**SEASON**	**Heavy Metals**					
			Nickel (Ni)	Copper (Cu)	Zink (Zn)	Chromium (Cr)	Cadmium (Cd)	Mercury (Hg)
		Unit	MgL^{-1}	MgL^{-1}	MgL^{-1}	MgL^{-1}	MgL^{-1}	MgL^{-1}
1.	**Shabazpur Dor**	February (*Winter*)	2.23	2.34	1.26	2.38	2.82	1.28
		May (*Pre-Monsoon*)	2.28	2.13	1.16	2.65	2.62	1.30
		August (*Monsoon*)	2.31	2.98	1.32	2.85	2.38	2.10
		October (*Post-Monsoon*)	2.29	2.97	1.26	2.39	2.42	1.34
2.	**Naipura Khadar**	February (*Winter*)	2.32	2.21	2.91	2.43	2.42	1.78
		May (*Pre-Monsoon*)	2.32	2.81	2.92	2.12	2.82	1.76
		August (*Monsoon*)	2.48	2.62	2.97	2.62	2.62	1.84
		October	2.51	2.42	2.95	2.82	2.32	1.83

		(*Post-Monsoon*)						
3.	**Tigaria Bhur**	February (*Winter*)	2.41	3.01	2.12	2.10	2.68	1.84
		May (*Pre-Monsoon*)	2.31	3.26	2.11	2.98	2.32	1.74
		August (*Monsoon*)	2.41	2.82	1.98	2.20	2.48	1.84
		October (*Post-Monsoon*)	2.31	2.61	1.62	2.32	2.62	1.42
4.	**Sultanpur Dhar**	February (*Winter*)	2.41	3.02	2.81	2.18	1.98	1.93
		May (*Pre-Monsoon*)	2.31	3.62	2.10	2.30	2.80	1.92
		August (*Monsoon*)	2.36	2.81	1.98	1.90	2.90	1.96
		October (*Post-Monsoon*)	2.34	2.81	1.62	2.78	2.72	1.92
5.	**Soharka**	February (*Winter*)	2.51	3.12	2.61	3.21	2.10	1.72
		May (*Pre-Monsoon*)	2.52	3.00	2.51	3.12	2.30	1.62
		August (*Monsoon*)	3.42	3.32	2.62	2.96	1.98	1.28
		October (*Post-Monsoon*)	2.31	3.14	2.62	2.10	1.62	1.87

Source: Calculation is based on sample survey.

Table 2. Heavy Metals of River Bagad at Selected Sampling Stations in Year 2011.

Sampling Station		**SEASON**	**Heavy Metals**					
			Nickel (Ni)	Copper (Cu)	Zink (Zn)	Chromium (Cr)	Cadmium (Cd)	Mercury (Hg)
		Unit	MgL^{-1}	MgL^{-1}	MgL^{-1}	MgL^{-1}	MgL^{-1}	MgL^{-1}
1.	**Shabazpur Dor**	February (*Winter*)	2.25	2.42	2.36	2.18	2.09	1.96
		May (*Pre-Monsoon*)	2.36	2.71	2.42	2.12	2.08	1.89
		August (*Monsoon*)	2.28	2.81	2.41	2.16	2.12	1.91
		October (*Post-Monsoon*)	2.56	2.71	2.62	2.09	2.14	1.93
2.	**Naipura Khadar**	February (*Winter*)	2.29	3.81	2.92	2.06	2.12	1.84
		May	2.32	3.18	2.96	2.13	2.16	1.84

		(*Pre-Monsoon*)						
		August (*Monsoon*)	2.36	2.92	3.12	2.36	2.98	1.86
		October (*Post-Monsoon*)	3.32	2.86	3.82	2.86	3.16	1.73
3.	**Tigaria Bhur**	February (*Winter*)	2.46	3.01	2.16	2.18	3.12	1.73
		May (*Pre-Monsoon*)	2.36	3.12	2.17	2.12	3.13	1.82
		August (*Monsoon*)	2.48	3.32	2.89	2.13	2.10	1.84
		October (*Post-Monsoon*)	2.49	3.43	2.90	2.14	2.80	1.74
4.	**Sultanpur Dhar**	February (*Winter*)	2.46	3.18	2.81	2.41	1.98	1.26
		May (*Pre-Monsoon*)	2.45	3.14	2.91	2.68	2.15	1.78
		August (*Monsoon*)	2.42	3.16	2.71	3.00	2.17	1.92
		October (*Post-Monsoon*)	2.41	3.14	2.42	2.98	2.20	1.62
5.	**Soharka**	February (*Winter*)	2.52	3.26	2.82	2.32	2.10	1.64
		May (*Pre-Monsoon*)	2.32	3.26	2.81	2.18	2.80	1.63
		August (*Monsoon*)	2.42	4.26	2.62	2.46	2.98	1.78
		October (*Post-Monsoon*)	2.62	3.48	2.42	2.23	2.30	1.68

Source: Calculation is based on sample survey.

Chromium is an essential element for life, and stimulates growth of terrestrial and aquatic animals. In natural surface water, chromium exists mainly as either Cr^{3+} or Cr^{6+} depending on the air availability. In aerated waters Cr will be the principle form which will get reduced to Cr^{3+} under anaerobic conditions. The amount of reduction is dependent upon the presence of the amount of organic matter. In the present study, the concentration of chromium varied between 1.90 mg/l to 3.21 mg/l. The highest concentration of chromium 3.21 mg/l was recorded at Soharka during the month of February 2010. The minimum concentration of chromium 1.90 mg/l recorded at Sultanpur Dhar during the month of August 2010.

Cadmium is bio-persistent in nature and once contaminated by organism remains for many years (Berkowitz *et al.,* 2008). Cadmium metal is used in

the steel industry besides plastic, phosphate, fertilizer, cadmium batteries. Cadmium does not stay long time in natural water; either it is precipitated as carbonate or it is adsorbed on to particulate matter and incorporated in to the bottom sediment. In the present study cadmium values varied between 1.62 mg/l to 3.16 mg/l. The highest value of cadmium 3.16 mg/l was recorded at Naipura Khadar during the month of October 2011. The minimum value of cadmium 1.62 mg/l was recorded at Soharka during the month of October 2010 (Post-Monsoon).

Mercury is a metal which exists in the earth's crust. It can be released by weathering and transported by stream waters. Mercury is very toxic in nature and creates adverse impacts on human health. Birket *et al.,* (2002) reported that organic matter is not a major factor that controls the mercury distribution. Benthic macro-invertebrates also play important role in the mobilization of mercury form the bottom to the superficial sediment and to the water column. Several studies have shown that mercury is less bio-available in sediment that is rich in organic matter (Luoma, 1989). The mercury values varied between 1.26 mg/l to 2.10 mg/l during the study time. The highest value of mercury 2.10 mg/l was recorded at Shabazpur Dor during the month of August 2010, while the lowest value of mercury 1.26 mg/l was recorded at Sultanpur Dhar during the month of February (Winter) 2011.

In order for a metal to be toxic, it needs to enter the body of the exposed organism and interact with the surface or interior of cells. There are several pathways by which this happens. In addition to diffusion into the blood stream via the gills and skin, fish can exposed by drinking water or eating sediments that are contaminated with the metal, or eating other animal or plants that have been exposed to the metal. Humans are exposed to metals via analogous pathways i.e. diffusion in the bloodstream via the lungs and skin, drinking contaminated water and eating contaminated food.

REFERENCES

Drever, J. I., (1997): The Geochemistry of Natural waters, third ed. *Prentice Hall*, New Jersey.

Kennish, M. J., (1992): Environmental threats and environmental future of estuaries. *Environ. Conserv*. 29(1): 78-107.

Purves, D., (1985): Trace-element Contamination of the Environment. *Elsevier*, Amsterdam.

Ma, L. Q., Rao, G. N., (1997): Chemical fractionation of cadmium, copper, nickel and zinc in contaminated Soils. *J. Environ. Qual*. 26: 259-264.

Nuruberg, H. W., (1984): The Volta metric approach in trace metals chemistry of natural waters and atmospheric precipitation. *Anal. Chim. Acta* 164: 1-21.

Cook, J.A., Andrew, S.M., Johnson, M.S., (1990): Lead, zinc, cadmium and fluoride in small mammals from contaminated grass-land established on flourspur tailings. *Water Air Soil Pollut*. 51; 43-54.

Deniseger, J., Ericson, L. J., Austin A., Rock, M., Clarck, M. J. R., (1990): The effect of decreasing heavy metal concentrations on the biota of Buttle Lake Vancouver Island, British Columbia. *Water Res.*24: 403-416.

Scoullous, M., Hatzianestis, J., (1989): Dissolved and particulate Trace metals in a Wetland of International Importance: Lake Mikri Prespa, Greece. *Water Air Soil pollut*. 44: 307-320.

Jain, C. K., Singhal, D. C., Sharma, M. K., (2004): Adsorption of zinc on bed sediment of River Hindon: adsorption models and kinetaics. J. Hazar. Mater. 114: 231-239.

Berkowitz, B., Dror, I., Yaron, B., (2008): Contaminant Geochemistry: Interaction and Transport in the Subsurface Environment. *Springer, Berlin.*

Birkett, J. W., Noreng, J. M. K., Lester, J. N., (2002): Spatial distribution of mercury in the sediments and riparian environment of the River Yare Norfolk. *U. K. Environ. Pollut*.116: 65-74.

Luoma, S. N., (1989): Can we determine the biological availability of sediment-bound trace elements? *Hydrobiologia* (176-177): 379-396.

SHORT COMMUNICATION

ASSESSMENT OF CROPPING SYSTEMS TOWARDS FARMERS IN BALOD DISTRICT OF CHHATTISGARH STATE

Laleeta Sahu*, D.J. Sarkar, M.A. Khan, Y.S. Dhruw and A.K. Singh

Department of Agricultural Extension, IGKV Raipur (C.G.) 492012
Email: laleetasahu081@gmail.com

Received-12.10.2015, Revised-19.10.2015

Abstract: This study was focused on assessment of cropping systems towards farmers in Balod District of Chhattisgarh state. In this context, the present study was carried out in Balod, Dondi and Gunderdehi blocks of Balod District (Chhattisgarh) during the year 2014-15. The findings indicate that the majority of the respondents (29.17%) had follow the Rice-Wheat cropping system and most of the respondents (83.33%) had intensity of cropping of more than 100 per cent. Area under existing cropping systems shows that total 252.60 ha area is used by the big farmers for different cropping systems, out of which the cropping system Rice-Wheat occupies 17.97 per cent of area as majority. area under existing cropping systems shows that total 252.60 ha area is used by the big farmers for different cropping systems, out of which the cropping system Rice-Wheat occupies 17.97 per cent of area as majority.

Keywords: Cropping system, Cropping intensity, Irrigation

INTRODUCTION

The cropping system study is useful to understand the overall sustainability of agricultural system. A cropping system is defined as the crops and crop sequences, their management techniques used on a particular field over a period of years. Despite the focus on industrialization, agriculture remains a dominant sector of the Indian economy both in terms of contribution to gross domestic product (GDP) as well as a source of employment to millions across the country. Agriculture plays a vital role in the Indian economy. The total Share of Agriculture & Allied Sectors (Including agriculture, livestock, forestry and fishery sub sectors) in terms of percentage of GDP is 13.9 percent during 2013-14 at 2004-05 prices. [As per the estimates released by Central Statistics Office]. As per the land use statistics 2011-12, the total geographical area of the country is 328.7 million hectares, of which 140.8 million hectares is the reported net sown area and 195.2 million hectares is the gross cropped area with a cropping intensity of 138.7%. The net irrigated area is 65.3 million hectares. As per the 4th Advance Estimates of Production of food grains for 2013-14, total food grain production is estimated to be 264.77 million tonnes (MT). In 2013-14, India achieved a record food grain production of 264 MT, beating the previous year's (2012-13) 257 MT, according to data provided by Department of Economics and Statistics (DES). Also, agricultural profitability has increased over the last decade with record increases in MSPs (minimum support prices) for agricultural produce for all covered crops. The Agriculture and Allied Sector contributed approximately 13.9% of India's GDP (at constant 2004-05 prices) during 2013-14. (Annual report 2013-14).

Chhattisgarh state is the 10^{th} largest state in India, with an area of 135.190 km^2 (52000 m^2) with a population of 25.5 million. Chhattisgarh state consists of 27 districts. According to a government estimate, net sown area of the state is 4.828 million ha and the gross sown area is 5.788 million ha. ("Agriculture in Chhattisgarh", Retrieved on 22 July, 2011). Agriculture in Chhattisgarh is marked by rain fed farming, low value, low yield dominant cropping pattern and a large share of dependent population. Canals are the main source of irrigation in the state and they are dependent on rainfall only. Though a substantial portion of the population is dependent on agriculture, the major crops produced in the state being paddy, kodo-kutki, maize, wheat, gram, lathyrus, niger, linseed, mustard, soybean and ground nut, nearly 80% of State's gross cropped area is covered by one crop i.e. Paddy. As per data compiled by NABARD in their State Focus Paper 2014-15 and Indira Gandhi Krishi Vishwavidhyalaya, Raipur in Krishi Darshika 2014, on cropping pattern and cropping intensity for the State of Chhattisgarh the cropping intensity is only 137%, which means that only 37% area is doubled cropped as virtually mono cropping. Cropping pattern of the state shows production in Kharif is 73.50% and in Rabi, it is 26.50 %. Kharif production is mainly depends upon rain fall. Entire economy of the state mainly depends on single crop produced in the state i.e. in Kharif. (Annual report 2013-14) The research area Balod is the 19^{th} district of Chhattisgarh. Balod was established as a district on 1^{st} January 2012. It is situated in southern region of Chhattisgarh. The total geographical area of Balod is about 278000 ha. According to a government estimate, net sown area of the district is 176.8 ha, Area sown more than once is 79.0 ha and the gross sown area is 255.8 ha with a cropping intensity of 143% ("Agriculture in Chhattisgarh", Retrieved on 22 July, 2011).

*Corresponding Author

METHODOLOGY

This study was conducted during the year 2014-15 in the Balod District of Chhattisgarh state. The Chhattisgarh state consists of 27 districts, out of which Balod district was selected because the sizeable number of big farmers of this district followed various type of cropping systems. Out of the total 5 blocks in Balod district, 3 blocks namely Balod, Dondi, and Gunderdehi were selected purposively for the study because the maximum numbers of big farmers are following various cropping systems residing in these blocks. From each selected block, 5 villages (Total 5 X 3 = 15) were selected on the basis of maximum availability of cropping systems follower farmers in the villages. Village Semarkona, Baghmara, Orma, Jhalmala and Heerapur from Balod block, Kotagaon, Salhaitola, Chhindgaon, Dhhotimtola and Adjaal from Dondi block and Barbaspur, Mokha, Jewartala, Bhardakala and Mundara from Gunderdehi block were selected randomly. From each selected village, 8 big farmers were selected randomly as respondents. Thus a total of 120 farmers were chosen for the study that followed various types of cropping systems.

RESULT AND DISCUSSION

Existing cropping systems

The data on existing cropping systems are presented in Table 1.1. The findings indicate that the majority of the respondents (29.17%) had follow the Rice-Wheat cropping system, followed by 20.83 per cent of the respondents had follow the Rice-Vegetables cropping system, 18.33 per cent of the respondents had follow the Rice-Lentil cropping system, 16.67 per cent of the respondents had follow the Rice-Fallow cropping system, 15.00 per cent of the respondents had follow the Rice-Chickpea cropping system, 12.50 per cent of the respondents had follow the Maize-Linseed cropping system, 10.00 per cent of the respondents had follow the Maize-Mustard cropping system, 9.17 per cent of the respondents had follow the Rice-Sugarcane cropping system, and at last, 8.33 per cent of the respondents had follow the Soybean-Chickpea, 7.50 per cent of the respondents had follow the Rice-Rapeseed cropping system, 6.67 per cent of the respondents had follow the Rice-Rice cropping system, and 5.83 per cent of the respondents had follow the Blackgram-Chickpea cropping system, respectively.

Table 1. Distribution of the respondents according to existing cropping systems

S.N.	Category	Frequency	Percentage	Rank
1.	Rice-Fallow	20	16.67	IV
2.	Rice-Rapeseed	09	07.50	X
3.	Maize-Mustard	12	10.00	VII
4.	Rice-Rice	08	06.67	XI
5.	Maize-Linseed	15	12.50	VI
6.	Soybean-Chickpea	10	08.33	IX
7.	Rice-Sugarcane	11	09.17	VIII
8.	Blackgram-Chickpea	07	05.83	XII
9.	Rice-Wheat	35	29.17	I
10.	Rice-Chickpea	18	15.00	V
11.	Rice-Lentil	22	18.33	III
12.	Rice-Vegetables	25	20.83	II

*Data are based on multiple responses

Cropping intensity

The data on cropping intensity are presented in Table 1.2. The intensity of cropping, therefore, refers as a ratio between net sown area (NSA) and gross cropped area (GCA). It thus indicates the additional percentage share of the area sown more than once to NSA. The finding revealed that in the study area, most of the respondents (83.33%) had intensity of cropping of more than 100 per cent, while 16.67 per cent of the respondents had intensity of cropping of upto 100 per cent.

Table 2. Cropping intensity of various cropping patterns followed by the respondents n = 120

S.N.	Cropping intensity (%)	Frequency	Percentage
1.	Upto 100 percent	20	16.67
2.	More than 100 percent	100	83.33

Area under existing cropping systems

The table 1.3 shows that total 252.60 ha area is used by the big farmers for different cropping systems, out of which the cropping system Rice-Wheat occupies 17.97 per cent of area, while the cropping system Rice-Vegetables occupies 15.20 per cent, cropping system Rice-Lentil occupies 11.40 per cent, cropping system Rice-Sugurcane occupies 10.05 per cent, cropping system Rice-Chickpea occupies 9.03 per cent, cropping system Rice-Fallow occupies 8.08 per

cent, cropping system Maize-Linseed occupies 5.62 per cent, cropping system Soybean-Chickpea occupies 5.07 per cent, cropping system Rice-Rapeseed occupies 4.75 per cent, cropping system Maize-Mustard occupies 4.44 per cent, cropping system Blackgram-Chickpea occupies 4.27 per cent, and cropping system Rice-Rice occupies 4.12 per cent of the total area.

Table 3. Area under existing cropping systems n=120

S.N.	Name of cropping system	Area (ha)	Percentage	Rank
1.	Rice-Fallow	20.40	08.08	VI
2.	Rice-Rapeseed	12.00	04.75	IX
3.	Maize-Mustard	11.20	04.44	X
4.	Rice-Rice	10.40	04.12	XII
5.	Maize-Linseed	14.20	05.62	VII
6.	Soybean-Chickpea	12.80	05.07	VIII
7.	Rice-Sugarcane	25.40	10.05	IV
8.	Blackgram-Chickpea	10.80	04.27	XI
9.	Rice-Wheat	45.40	17.97	I
10.	Rice-Chickpea	22.80	09.03	V
11.	Rice-Lentil	28.80	11.40	III
12.	Rice-Vegetables	38.40	15.20	II
	Total	**252.60**	**100.00**	

REFERENCES

Anonymous (2005b). FAO. http://www.fao.org/documents/en/detail.

Anonymous (2011). Indiastat. www.indiastat.com.

Anonymous (2013c). Statewise estimates of value of output from agriculture and allied activities. Central Statistics Office (Ministry of Statistics and Programme Implementation, Government of India, New Delhi-110001.

Chandra, P. (2001). A study on rate of adoption and consequences of hybrid paddy in Cauveri command area, Karnataka state. *M.Sc. (Ag.) Thesis*, University of Agriculture Sciences, Dharwad.

Choudhary, R.P., Singh, P. and Mishra, B. (2001). Correlates of adoption of improved rice production technology. *Indian Journal of Extension Education*. **37**(3&4): 200-201.

Gogoi, M., Phukan, E. and Talukdar, R.K. (2000). Impact of farmer training programme on rice production technology by farmers. *Maha. J. Extn. Edn.*, 19: 232-238.

Gupta, S. P., Amardeep and Kushal (2003). Utilization of information source by farmers under different production system in Uttranchal and Uttar Pradesh, *Manage Extension Research Review*, **4**(2): 70-80.

Hedau, J. (2000). Need assessment of the farmers from their perceptive related to adoption of paddy production technology in Raipur district of M.P. Unpublished *M.Sc. (Ag.) Thesis*, IGKV, Raipur.

SHORT COMMUNICATION

PROFILE CHARACTERISTICS OF TOMATO GROWING FARMERS OF JASPUR DISTRICT OF CHHATTISGARH STATE

Biseshwar Sxena[1]and S. Narbaria*[2]

Department of Agricultural Extension, Collage of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur – 492012 (C.G.), India
Email: sunilag22@gmail.com

Received-10.10.2015, Revised-20.10.2015

Abstract: The present investigation was carried out in the six purposively selected villages of Pathalogon Block of Jashpur district. Seventy two respondents were selected randomly and personally interviewed with the help of the structured interview schedule. The study revealed that the majority of the respondents were in the young age group (up to 35 years) with high school level of education. Majority of the respondents belongs to medium size families and they had maximum experience 11 to 20 years in tomato cultivation and most of the respondents were belonging to schedule tribe category of caste. Regarding the socio-economic characteristics, the study revealed that majority of tomato growers (47.22%) had big size of land holding and only 12.5 percent belonged to small farmer category. The majority of them (34.72%) belonged to annual income category of up to Rs. 25,000 while only few had more than Rs 75,000 income per year. Majority of respondents i.e. 52.77 percent had high level of economic motivation and only 8.33 percent respondents had low level of economic motivation about tomato production technology.

Keywords: Tomato Cultivation, Socio-economic, Characteristics

INTRODUCTION

Vegetables not only provide maximum output but also give more income per unit area of land. Vegetable cultivation among small land holders has always been source of supplementary income and provides gainful employment through intensive cultivation and thus vegetable growers are normally more prosperous than those who grow cereals, because of higher return. The Jashpur district in Chhattisgarh State is famous for tomato production, in spite of having totally rainfed area. The tomato crop covers an area of 2577 hectare and production is 51560 tones as recorded by the Horticulture department of Raigarh (1996-1997). In order to increase the production of tomato crop, several improved varieties have been released during the recent years. Concentrated work has been undertaken by the govt. officials / extension personnel to promote adoption of improved cultivation practices of tomato crop. Scientist / Researcher advocate the use of package of tomato production technology with which the farmers have to be convinced, so that they can adopt the improved technologies in their farming system. If scientific methods are followed it gives almost 300-q/ha yield in open pollinated varieties and upto 880 qui/ha in case of hybrids (www.cgagridept.in).

MATERIAL AND METHOD

Location of the study

The study was conducted in the Jaspur district of the Chhattisgarh state. The Chhattisgarh state consists of 27 districts, out of which Jaspur district was selected because the maximum area of tomato cultivation quite high among all the districts of Chhattisgarh state. Out of 8 blocks of Jashpur district, only Pathalgaon block was selected purposively for the study because it has the largest area under tomato cultivation in comparison to other blocks in the district. The Pathalgaon block has a total number of 110 villages, out of which thirty villages having highest area and production under tomato crop. Out of these villages, six villages namely Bildegi, Bandhanpur, Birindega, Ludig, Mudapara, Saraitola selected using SRSWOR (Simple Random Sampling without Replacement) technique for the study.

Method of data collection

A list of the tomato growers of the selected villages was prepared. The name of the tomato growers were arranged alphabetically and twelve tomato growers from each selected village were selected on random basis. Thus, seventy-two respondents were finally selected for the purpose of conducting this study. The data were collected with the help of well structured and pre-tested and well structured interview schedule.

RESULT AND DISCUSSION

Socio-personal characteristics of the

The independent variables i.e. age, education, caste, size of family and experience of tomato cultivation were considered as socio personal characteristics of the respondents and the results are presented in Table 1.

*Corresponding Author

Table 1. Distribution of the respondents according to their socio-personal characteristics of the tomato growing farmers

Characteristics	Frequency	Percentage
Age (years)		
• Young (upto 35)	33	45.83
• Middle (35-50)	32	44.44
• Old(>50)	7	9.72
Education		
• Illitrate	16	22.22
• Primary	16	22.22
• Middle	14	19.45
• High school	23	31.94
• Higher secondary	2	2.78
• Undergraduate	1	1.39
Caste		
• Schedule caste (SC)	10	13.89
• Schedule tribe (ST)	39	54.17
• Other Backward class (OBC)	13	18.05
• General (G)	10	13.89
Size of family		
• Small (upto 4 members)	27	37.5
• Medium (5-8 members)	33	45.83
• Big (> 8 members)	12	16.66
Experience of tomato cultivation		
• Low Upto 10 years	30	41.66
• Medium 11 to 20 years	37	51.38
• High Above 20 years	5	6.44

Data as shown in table 1 revealed that the majority of the respondents i.e. 45.83 per cent were belonging to young age group, 44.44 per cent were of middle age and 9.72 per cent belonged to old age group. This indicates that most of the farmers, (young and middle age group) were having more interest to learn and adopt tomato production technology, as compared old age group of the tomato growers. Similar findings were also reported by Kushwaha (1996) that the young age group of tomato growers adopted modern tomato production technology. Among the 72 tomato growers, about 31.94 per cent farmers had education up to high school level and 22.22 per cent farmers educated up to primary school level and same per cent of the tomato growers also belonged to illiterate category whereas 19.45, 2.78 and 1.39 per cent farmers were educated up to middle school, higher secondary and under graduate level respectively. Such reflection was a good sign of spreading the knowledge of tomato production technology to boost the tomato production. Kushwaha (1996) studied that education of the respondents had a greater role in the adoption of tomato production technology. Majority of the tomato growing farmers belonged to the scheduled tribe caste i.e. 54.17 per cent whereas, 18.05 per cent farmers were belonged to other backward class followed by 13.89 per cent in both the category under schedule caste and general caste respectively. The results also indicated that majority of the tomato growing farmers were having medium size of family (45.83 %) whereas 37.5 and 16.66 per cent belonged to small and big size of family respectively. Further, the data also indicate that majority of the respondents (51.38%) were having 11 to 20 years of tomato farming experience, whereas 41.66 per cent of the respondents were having upto 10 years of tomato farming experience and only 6.94 per cent of the respondents were having more than 20 years of tomato farming experience as low and high category of experience. Gopalakrishna (1972) and Shrivastava (2001) noted similar findings.

Socio-economic characteristics of the respondents

The data presented in table 2 reveal that majority of the tomato growing farmers (47.22%) belonged to big and medium (40.27%) category, whereas about 12.5 per cent of tomato growing farmers belonged to small category of land holding.

Table 2. Distribution of the respondents according to their land holding

Category	Frequency	Percentage
• Small (1-5 acres)	9	12.5

• Medium (5.1-10 acres)	29	40.27
• Big (> 10 acres)	34	47.22

Annual income

Annual income of the respondents as given in Table 3.Indicates that 34.72 per cent of tomato growing farmers reported their annual income to be up to Rs. 25000, whereas 31.94 per cent respondents had their annual income higher than Rs. 75000. 22.22 And 11.11 per cent of respondent had their annual income between Rs. 25001 to 50000 and Rs. 50001 to 75000 respectively. The data also show that majority of the tomato growing farmers were getting high level of income from the tomato production.

Table 3. Distribution of the respondent according to their annual income

Category	Frequency	Percentage
• Up to Rs. 25000	25	34.72
• Rs. 25001 to 50000	16	22.22
• Rs. 50001 to 75000	8	11.11
• Rs. > 75000	23	31.94

Economic Motivation

Majority of the respondents i.e. 52.77 per cent had high level of economic motivation, whereas 38.88 per cent respondents had medium level of economic motivation and only 8.33 per cent respondents had low level of economic motivation. It might be due to the awareness about profitable cultivation among the tomato growing farmers which reflects a good sign for improvement in socio-economic status of the farmers. Aswathaiah (1972) and Rajgopal (1975) also found similar finding.

Table 4. Distribution of the respondent according to their annual income

Category	Frequency	Percentage
• Low economic motivation	6	8.33
• Medium economic motivation	28	38.88
• High economic motivation	38	52.77

REFERENCES

Aswathaiah, B., Krishna, K. S., Siddaramaiah, B. S. (1972). A study of the extent of adoption of improved practices in respect of chilli cultivation. Farm Journal, 12, No. 12.

Kushwaha, P. L. (1996). Adoption behaviour in relation to economics of tomato production in Maihar block of Satna district, Mahdya Pradesh. M. Sc. (Ag.) thesis College of agriculture, JNKVV, Jabalpur.

Gopalakrishna, C. (1972). A study on the adoption of recommended potato practices by farmers of Hoskote taluk, Bangalore District. M. Sc. thesis (unpublished), University of Agricultural Sciences, Bangalore..

Rajgopal (1975). Plant protection practices and problems of vegetable growers in Bangalore district, Directorate of extension UAS. Mysore J. of Agric. Economics. 9:499-509.

Shrivatava, K.K., Patel, H.L., Lakhera, M.L., Awasthi, H.K. and Singh, P.R. (2001). Knowledge level of farmers about chilli production technology. Abstract published in workshop cum seminar on sustainable agriculture for 21st Century, held at IGAU, Raipur on Jan, 20-21, 2001, **pp30. www.cgagridept.in**