Agric. Sci. Digest., 36 (3) 2016: 197-201
Print ISSN:0253-150X / Online ISSN:0976-0547

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
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Biology and management of guava bark eating caterpillar (*Indarbela tetraonis* Moore)

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Received: 10-11-2015 Accepted: 06-04-2016 DOI:10.18805/asd.v0iof.11153

ABSTRACT

An experiment on the biology of guava bark eating caterpillar (*Indarbela tetraonis* Moore) was conducted during 2012-13 at College of Horticulture, Bidar. Eggs were 0.67 to 0.73 mm long and 0.42 to 0.46 mm wide and they hatched in 7 to 11 days. Full grown larvae were 37 to 43 mm long and 6 to 8 mm wide. Larval duration was 274 to 298 days. Pupae were 11 to 15 mm long and 4 to 6 mm wide and the pupal period was 21 to 26 days. Male adult had wing span of 11 to 13 mm length and width of 20 to 24 mm. Female adult had wing span of 12 to 14 mm and width of 25 to 27 mm, Chlorantraniliprole 18.5 SC registered 100 percent control of the pest and highest yield of 24.85 t/ha and 25.00 t/ha during 2013 and 2014, respectively.

Key words: Biology, Guava Bark Eating Caterpillar, *Indarbela tetraonis* Moore, Management, Morphometry, Yield.

INTRODUCTION

Guava (*Psidium guajava* L.) fruit, appealing for its unique tropical flavours, is considered as an excellent source of nutrients and antioxidants, phytochemicals, especially ascorbic acid. After acerola cherries, guava has been reported as the second highest source of ascorbic acid (ranging from 60-1000 mg/100 g) of all fruits (Mitra, 1997).

In India guava is grown on 2.36 lakh ha with production of 3.19 million tonnes (Anonymous, 2014). Like many other crops guava is affected by several pests and other factors which result in the reduction of yield. More than 80 species of insects have been reported in one form or another, affect the quality and yield of guava (Sarita, 2012). Among them Bark eating caterpillar, (*Indarbela tetraonis*) Moore is now-a-days becoming one of the serious production constraint (Dharam, 2012). Besides, pest is also known to infest other crops *viz.*, ber, citrus, jack-fruit, jamun, loquat, pomegranate, mango, aonla, rose, mulberry, phalsa, rambutan and logan (Dharam, 2012).

Since the insect lives in concealed tunnels and comes out only to feed on the bark, further, it takes several months to complete the life cycle. The carabaryl 50 WP @ 4 g per litre of water (Anonymous, 2012); removal frass ribbon from the infested tree (Anonymous, 2014a) are the only management strategies available to contain the pest. No holistic information is available regarding its biology to design reliable management tactics. Hence, an investigation was undertaken to generate the data and document results regarding the biology and management of the pest.

MATERIALS AND METHODS

A study was undertaken on the biology and management of Guava bark eating caterpillar in an experimental plot of 96 guava trees (10 years old) planted at 7.5 m X 7.5 m spacing at College of Horticulture, Bidar during 2012-13 and 2013-14, respectively.

Biology of guava bark eating caterpillar: The magnitude of infestation was estimated by examining 25 randomly selected tagged plants by following the score classes (George Mathew, 1997).

Score 0 = Healthy tree with no borer attack
Score 1 = Tree infested by only one borer (low infestation)
Score 2 = Tree affected by 2 to 4 borers (medium infestation)
Score 3 = Tree with more than 4 borers (heavy infestation)

To study the biology, infested trees belonging to score 2 and above were selected and were tagged. *In situ* or field observation were made on the live tunnels in each infested tree by cutting the branches, at weekly interval. The presence of the larva inside the tunnel was ascertained by the presence of the sleeve (a path, roofed with the silk and fragments of bark from shelter tunnel to the place where larva feeds). Besides, to confirm the observations made in the field, the infested branches were collected from the field and reared in cages measuring 3ft X 3ft X 3ft under the laboratory conditions. To keep the branches fresh for longer period the floor of the cages were spread with 8cm thick layer of moist sieved sand.

(i) Morphometric features: A standard ocular micrometer fitted to a stereoscopic binocular microscope was used to measure length and breadth of various stages (egg, larva, pupa, adult male and female) after calibrating it with stage micrometer slide. (ii) Durations of different stages of the insect *viz.*, egg, larva, pupa, male adult longevity, female adult longevity, male total life period and female total life

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period were recorded. The mean and standard deviation of each parameter of the data was worked out to draw inference. Management of Guava bark eating caterpillar: A field study was conducted during 2013 and 2014 in guava orchard in Bidar. Eight insecticides *viz.*, Indoxacarb 15.8 SC, Azadirachtin (1500ppm), NSKE 5%, Dichlorvos 76 EC, Deltamethrin 2.8 EC, Chlorantraniliprole 18.5 SC, Lambda Cyhalothrin 5 EC and Chlorpyriphos 20 EC with different modes of action were evaluated along with untreated check (Table-3). Two live holes per tree were marked (active holes inhabited by the caterpillars as indicated by the excreta, frass and gummy exudate) and four such marked trees per treatment were selected. The experiment was laid out in randomized block design (RBD) with 3 replications. The treatments were imposed by injecting the insecticides in the active holes inhabited by the caterpillars. Pre-treatment larval count a day before and post treatment observations on the larval mortality at 1, 3, 7 and 10 days after imposition of the treatments were made. The crumbled appearance of the 'sleeve' *i.e.*, stoppage of frass ribbon extension were taken as the criteria for death of the larva inside the tunnel. The observations on the larval mortality in each treatment were registered.

The percent fruit yield increase over control was calculated as follows.

Yield increase over control (%) =

$$\frac{\text{Yield in treatment plot} - \text{yield in control plot}}{\text{Yield in control plot}} \times 100$$

RESULTS AND DISCUSSION

Biology

Egg: The study indicated that moths laid light brown spherical eggs in clusters in the cracks and crevices of the bark. The data on the measurement of eggs revealed that the length of the eggs varied from 0.67 to 0.73 mm (average 0.69 ± 0.05 mm) and width 0.42 to 0.46 mm (average 0.44 ± 0.04 mm) (Table 1)

After 7 to 11 days (8.9 ± 0.98) of incubation the brown coloured neonate emerged from the egg (Table 2). The present findings on the colour, size and incubation of the eggs are in conformity with the reports of Anonymous (2012a); Saowanee and Jariya (2000).

Larva: The early instars were observed in groups and later moved out searching the concealed places on the shoots and bored a short tunnel downward in to the wood. The tunnel was used as shelter during the day hours. At night, the larvae came out and started feeding on the outer bark through a path made by the silken webbing and pieces of bark. As the larva put on the weight gradually made way through the tunnel and the tunnels were tubular in shape due to cylindrical shape of the larva (fig.1). The larva used the excreta and the frass mixture to prepare the sleeve from the tunnel to the feeding site on bark. The larvae fed heavily on the bark and exposed the interior to the secondary microbial infection. The full grown larva was 37 to 43 mm (average 37.6 ± 2.13mm) long and 6 to 8 mm wide (average 5.8 ± 0.71 mm) with glossy surface and sparsely distributed hairs on the body (Table 1 and fig 1.). The observations on the larval behaviour and morphological features are in line with the findings of Jha and Sen (2008); George Mathew (1997). The thoracic legs are simple with the last segment ending in a curved claw. The caudal end bears several small spine like processes. The larval duration ranged between 274 to 298 days (283.1 ± 7.69 days) (Table 2).

Pupa: The fully grown larvae pupated in the shelter tunnel itself and the brown coloured pupae were 11 to 15 mm long (average 12 ± 1.08 mm) and 4 to 6 mm wide (average 3.8 ± 0.69 mm) and the pupal period varied from 21 to 26 days (average 22.6 ± 1.52 days) (Table 1 and 2). The results obtained on the pupal period corroborate with the findings of Saowanee and Jariya (2000).

Adult: While emerging from the pupa moth left its pupal skin at the mouth of the bored hole (fig.1). The male adult had wing span of 11 to 13 mm length (average 11.2 ± 0.89mm) and width of 20 to 24 mm (average 20.7 ± 1.09 mm) (Table 1) and lived for 4 to 6 days (average 4.9 ± 0.69

Table 1: Morphometrics of different life stages of *Indarbela tetraonis*

Stage	Length (mm)		Width (mm)	
	Range	Mean ± SD	Range	Mean ± SD
Egg	0.67 to 0.73	0.69 ± 0.05	0.42 to 0.46	0.44 ± 0.04
Larva	37 to 43	37.6 ± 2.13	6 to 8	5.8 ± 0.71
Pupa	11 to 15	12 ±1.08	4 to 6	3.8 ± 0.69
Adult male	11 to 13	11.2 ± 0.89	20 to 24	20.7 ± 1.09
Adult Female	12 to14	11.9 ±0.76	25 to 27	25.2 ± 0.76

*Mean of 10 observations.

Table 2: Duration of different life stages of *Indarbela tetraonis*

Stage	Range	Mean±SD
Egg incubation period (days)	7 to 11	8.9 ± 0.98
Larval period (days)	274 to 298	283.1 ± 7.69
Pupal period (days)	21 to 26	22.6 ± 1.52
Male adult longevity (days)	4 to 6	4.9 ± 0.69
Female adult longevity (days)	4 to 6	5.3 ± 0.59
Male Total life period (days)	315 to 331	319.1 ± 7.49
Female Total life period (days)	312 to 337	319.9 ± 8.59

*Mean of 10 observations.

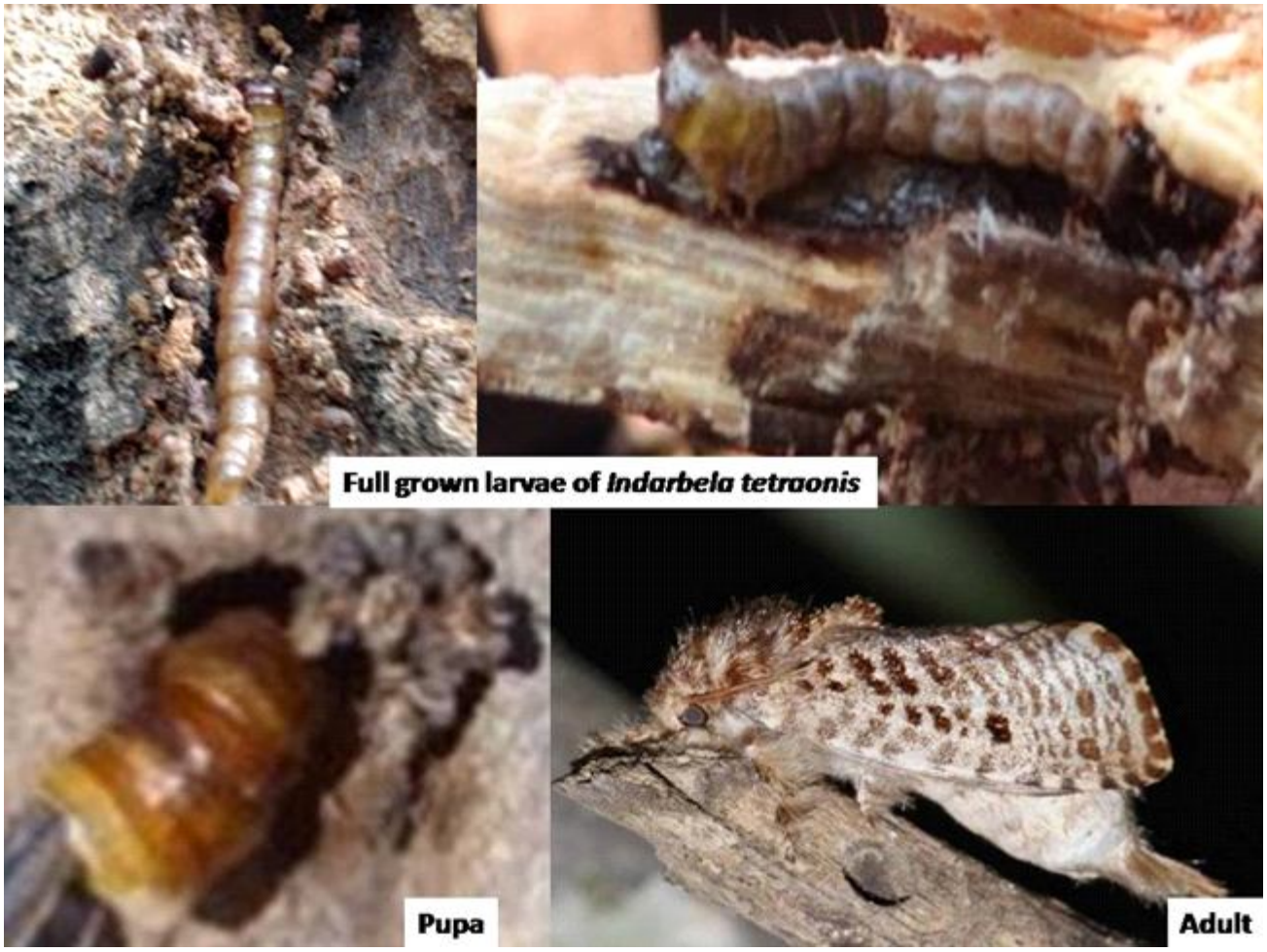

Fig 1: Different stages of guava bark eating caterpillar (*Indarbela tetraonis* Moore)

days) (Table 2). The female adult was bigger than the male with wing span of 12 to 14 mm length (average 11.9 ± 0.76 mm) and width 25 to 27 mm (average 25.2 ± 0.76 mm) and lived for comparatively longer period than male (4 to 6 days averaging 5.3 ± 0.59 days). The present findings are in agreement with observations made by Saowanee and Jariya (2000).

Management of guava bark eating caterpillar

Effect of different chemicals on larval mortality: The borer incidence was high during the study period. Among the 8 chemicals evaluated during 2013 for controlling the caterpillar Chlorantraniliprole 18.5 SC was the best with 2.36 larval mortality of the pest a day after the treatment imposition.The Indoxacarb 15.8 EC, Lambda cyhalothrin 5 EC and Deltamethrin 2.8 EC were next best in the row by causing the 1.97, 2.23 and 1.75 cumulative larval mortality, respectively. (Table 3). The Chlorpyriphos 20 EC and Azadirachtin (1500 ppm) were only superior over the control by registering 1.78 and 1.73 cumulative larval mortality, respectively. The Dichlorvos 76 EC recorded significantly lowest cumulative larval mortality (1.12). The larvae continued to feed on the untreated trees causing heavy feeding on the bark.

Similar trend was observed in the results obtained in the field trial conducted during 2014. The Chlorantraniliprole 18.5 SC was again best with 2.57 cumulative larval mortality. The Indoxacarb 15.8 EC, Lambda cyhalothrin 5 EC and Deltamethrin 2.8 EC were next best in the row by causing the 2.46, 2.24 and 2.22 cumulative larval mortality, respectively (Table 4). Chlorpyriphos 20 EC and Azadirachtin (1500 ppm) were only superior over the control by registering 2.81 and 2.00 cumulative larval mortality, respectively. Dichlorvos 76 EC recorded significantly lowest cumulative larval mortality (0.95). The larvae continued to feed on the untreated trees causing heavy feeding on the bark.

Impact of different chemicals on fruit yield of guava : The results on the fruit yield during 2013 (Table 5) revealed that the highest yield was registered in Chlorantraniliprole (24.85 t/ha) with maximum of 35.27 percent yield increase over control followed by Indoxacarb (23.93 t/ha) and Lambda cyhalothrin (23.34 t/ha). Lowest yield was recorded

Table 3: Management of guava bark eating caterpillar, (*Indarbela tetraonis*)-2013

Treatments	Dose(g or ml/l)	Larval Mortality Score					Cumulative
		1DBT	1DAT	3DAT	7DAT	10DAT	mortality
Indoxacarb 15.8% SC	0.3 ml/l	1.98(1.72)[a]	0.69(1.30)[b]	1.28(1.51)[a]	0(1.00)[b]	0(1.00)[a]	1.97
Azadirachtin (1500ppm)	3ml/l	1.90(1.70)[a]	0(1.00)[bc]	0(1.00)[b]	0.82(1.35)[a]	0.91(1.38)[a]	1.73
NSKE	5%	1.89(1.70)[a]	0(1.00)[bc]	0(1.00)[b]	0(1.00)[b]	1.24(1.49)a	1.24
Dichlorvos 76%EC	1.0 ml/l	2.36(1.83)[a]	0(1.00)[bc]	0(1.00)[b]	0(1.00)[b]	1.12(1.45)[a]	1.12
Deltamethrin 2.8%EC	0.5 ml/l	1.90(1.70)[a]	0(1.00)[bc]	1.25(1.50)[a]	0.37(1.17)	0.13(1.06)[a]	1.75
Chlorantraniliprole 18.5 SC	0.2 ml/l	2.36(1.83)[a]	2.36(1.83)[a]	0(1.00)[b]	0(1.00)[b]	0(1.00)[a]	2.36
Lambda Cyhalothrin5% EC	1.0 ml /l	2.28(1.81)[a]	0.2(1.09)[b]	1(1.41)[a]	1.03(1.42)[a]	0(1.00)[a]	2.23
Chlorpyriphos 20%EC	2.5 ml/l	1.89(1.70)[a]	0(1.00)[bc]	0.45(1.20)[a]	1.33(1.52)[a]	0(1.00)[a]	1.78
UTC	-	1.91(1.70)a	0(1.00)[bc]	0(1.00)[b]	0(1.00)[b]	0(1.00)[a]	0.00
SEm ±	0.19	0.10	0.06	0.16	0.19	-	
CD (p = 0.05)	0.55	0.30	0.17	0.47	0.58	-	

* Figures in parentheses $\sqrt{X+1}$ are transformed values used for statistical analysis
*Means with the same letters under the heads within the vertical columns are not different statistically (P=0.05) by DMRT
*DBT –Day Before Treatment, *DAT – Day (s) After Treatment

Table 4: Management of guava bark eating caterpillar, (*Indarbela tetraonis*) -2014

Treatments	Dose(g or ml/l)	Larval Mortality Score					Cumulative
		1DBT	1DAT	3DAT	7DAT	10DAT	mortality
Indoxacarb 15.8%SC-	0.3 ml/l	2.47(1.86)[a]	0(1.00)[c]	1.80(1.67)[a]	0.56(1.24)[a]	0.10(1.05)[c]	2.46
Azadirachtin (1500ppm)	3ml/l	2.35(1.83)[a]	0(1.00)[c]	0(1.00)[bc]	0.67(1.29)[a]	1.33(1.52)[a]	2.00
NSKE	5%	1.80(1.67)[a]	0(1.00)[c]	0(1.00)[bc]	0(1.00)[b]	1.12(1.45)[a]	1.12
Dichlorvos 76%EC	1.0 ml/l	2.1(1.76)[a]	0(1.00)[c]	0(1.00)[bc]	0(1.00)[b]	0.95(1.39)[b]	0.95
Deltamethrin 2.8%EC	0.5 ml/l	2.29(1.81)[a]	0.57(1.25)[b]	1.65(1.62)[a]	0(1.00)[b]	0(1.00)[d]	2.22
Chlorantraniliprole 18.5 SC	0.2 ml/l	2.57(1.88)[a]	2.57(1.88)a	0(1.00)[bc]	0(1.00)[b]	0(1.00)[d]	2.57
Lambda Cyhalothrin5% EC	1.0 ml /l	2.28(1.81)[a]	0(1.00)[c]	0.46(1.20)[b]	1.67(1.63)[a]	0.11(1.05)[c]	2.24
Chlorpyriphos 20%EC	2.5 ml/l	2.91(1.97)[a]	0.34(1.15)[b]	1.47(1.57)[a]	1(1.41)[a]	0(1.00)[d]	2.81
UTC	-	1.81(1.67)[a]	0(1.00)[c]	0(1.00)[bc]	0(1.00)[b]	0(1.00)[d]	0.00
SEm ±	0.25	0.17	0.13	0.11	0.12	-	
CD (p = 0.05)	0.66	0.48	0.36	0.35	0.34	-	

* Figures in parentheses $\sqrt{X+1}$ are transformed values used for statistical analysis
*Means with the same letters under the heads within the vertical columns are not different statistically (P=0.05) by DMRT
*DBT –Day Before Treatment
*DAT – Day (s) After Treatment

Table 5: Effect of different chemicals on fruit yield of guava

Treatments	Dose	2013			2014		
	(g or ml/l)	Total fruit weight/tree (kg)	Fruit yield (t/ha)	% fruit yield increase over control	Total fruit weight/tree (kg)	Fruit yield (t/ha)	% fruit yield increase over control
Indoxacarb 15.8%SC-	0.3 ml/l	135.22[b]	23.93[b]	30.27	136.02[b]	24.07[b]	30.04
Azadirachtin (1500ppm)	3ml/l	118.73[f]	21.02[f]	14.43	119.53[f]	21.16[f]	14.32
NSKE	5%	118.48[f]	20.97[f]	14.15	119.28[f]	21.11[f]	14.05
Dichlorvos 76%EC	1.0 ml/l	117.40[f]	20.78[f]	13.11	118.20[f]	20.92[f]	13.02
Deltamethrin 2.8%EC	0.5 ml/l	128.17[d]	22.69[d]	23.52	128.97[d]	22.83[d]	23.34
Chlorantraniliprole 18.5 SC	0.2 ml/l	140.42[a]	24.85[a]	35.27	141.22[a]	25.00[a]	35.06
Lambda Cyhalothrin 5% EC	1.0 ml /l	131.87[c]	23.34[c]	27.05	132.67[c]	23.48[c]	26.85
Chlorpyriphos 20%EC	2.5 ml/l	122.37[e]	21.66[e]	17.91	123.17[e]	21.80[e]	17.77
UTC	-	103.80[g]	18.37[g]	-	104.60[g]	18.51[g]	-
SEm ±	0.57	0.10		0.53	0.09		
CD (p = 0.05)	1.7	0.30		1.62	0.29		

*Means with the same letters under the heads within the vertical columns are not different statistically (P=0.05) by DMRT

in control (18.37 t/ha) (Table 5). The highest yield in the Chlorantraniliprole treated tree was the result of 100 per cent larval control which allowed the normal growth of the crop.

Similar trend was observed during 2014. Chlorantraniliprole was consistently superior by registering significantly highest yield 25.00 tonness per hectare which was 35.06 percent increase over control, followed by Indoxacarb (24.07 t/ha). Lambda cyhalothrin (23.48 t/ha) and Deltamethrin (22.83 t/ha) were on par with each other and were next best in row. Untreated control again recorded lowest yield (18.51 t/ha).

Overall the results of the two year study on management has shown that *Chlorantraniliprole* is the best followed by Indoxacarb, Azadirachtin, a botanical was moderately effective in reducing the borer and increasing yield.

ACKNOWLEDGEMENT

We thank College of Horticulture, Bidar and University of Horticultural Sciences, Bagalkot, India for their provisions to this study.

REFERENCES

Anonymous. (2012). *Package of Practices,* University of Horticultural Sciences, Bagalkot, Karnataka, pp.24.

Anonymous. (2012a). Insect pest management. *aipagropediaraichur*

Anonymous. (2014). Area and Production of Horticulture Crops. *Handbook of Horticulture Statistics*, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India New Delhi, p34

Anonymous. (2014a). Agroe-cosystem based analysis based IPM for guava. Department of Agriculture and co-operation, Ministry of Agriculture, Governement of India. p60

Dharam, P.A. (2012). Pests and pollinators of fruit crops. *Pollination Biology* **1:** 375-376

Jha and Sen, (2008). Pests of Acacia Species and their Management, *Forest Entomology*, A P H Publishing Corporation, New Delhi, pp45-46

Mathew, G. (1997). Management of the bark caterpillar *Indarbela tetraonis* in forest plantations of *Paraserianthes falcataria*, *Kerala Forest Research Institute, Peechi, Thrissur Report*. p.24

Mitra, S. (1997). Postharvest Physiology and Storage of Tropical and Subtropical fruits, *CAB International*: New York.

Saowanee, C and Jariya V. (2000). Infestation characteristics, life cycle and control of bark eating borer *Indarbela sp*. on longan tree, *FAO Report*

Sarita, P. (2012). Major insect pests that guava trees in India and their control. *http://www.yourarticlelibrary.com/biology/plants /24181*