Reaction of soybean varieties and efficiency of plant extract against Bihar hairy caterpillar [*Spilosoma obliqua walk*.]

THESIS

Submitted to the

Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior

In partial fulfilment of the requirement for the degree of

MASTER OF SCIENCE

In

AGRICULTURE

(ENTOMOLOGY)

By

KANHAIYA LAL THANNA

Department of Entomology

Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya

College of Agriculture

Gwalior (M.P.)

2014-15

CERTIFICATE – I

This is to certify that the thesis **"Reaction of soybean varieties and efficiency of plant extract against Bihar hairy caterpillar (*Spilosoma obliqua Walk.*)"** submitted in partial fulfilment of the requirement for the degree of **Master of Science in Agriculture (Entomology)** of **Rajmata Vijiyaraje Scindia Krishi Vishwa Vidyalaya, Gwalior** is a record of the bonafide research work carried out by **Kanhaiyalal Thanna** under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instruction.

No part of the thesis has been submitted for any other degree or diploma (Certificate awarded etc.) or has been published / published part has been fully acknowledged. All the assistance and help received during the course of the investigations has been acknowledged by him.

(Dr. N.S.Bhadouria)

Place : Gwalior
Date :

Chairman
Advisory Committee

Thesis approved by the students advisory committee

Chairman	**Dr. N.S. Bhadauria**
Member	**Dr. A.K. Singh**
Member	**Dr. P.D. Singh**
Member	**Dr. V.B. Singh**

CERTIFICATE – II

This is to certify that the thesis entitled **"Reaction of soybean varieties and efficiency of plant extract against Bihar hairy caterpillar (*Spilosoma obliqua Walk.*)''** submitted by **Kanhaiyalal Thanna** to the **Rajmata Vijiyaraje Scindia Krishi Vishwa Vidyalaya, Gwalior** in partial fulfilment of the requirements for the degree of **Master of Science in Agriculture (Entomology)** in the Department of **Entomology, College of Agriculture, Gwalior,** has been, after evaluation, approved by the External Examiner and by the Student's Advisory Committee after an oral examination of the same.

(Dr. N.S.Bhadouria)

Place : Gwalior
Date :

Chairman
Advisory Committee

Thesis approved by the students advisory committee

Chairman **Dr. N.S. Bhadouria**

Member **Dr. A.K. Singh**

Member **Dr. P.D. Singh**

Member **Dr. V.B. Singh**

Head of the Department (Dr. V.K. Shrivastava):……..

Dean of the collage (Dr. S.S. Tomar): …….

Director Instruction (Dr. R.L. Rajput):……..

ACKNOWLEDGEMENT

I will ever remain highly oblige to Chairman of my Advisory Committee Dr. N.S. Bhadauria Professor, Department of Entomology, College of Agriculture, Gwalior (M.P.) for his illuminative guidance, enthusiastic interest, dignified criticism and constant persuasion in successfully completing this research work.

I am highly gratitude to other member of my Advisory Committee Dr. A.K. Singh, Professor and head, Dept. of Plant breeding and Genetics, Dr. P.D. Singh, Associate Professor, Dep. Of Entomology, and Dr. V.B. Singh, Professor, Deptt. of Statistics, College of Agriculture, Gwalior (M.P.) for their expert guidance and kind help.

I feel myself duly bound to profound gratitude to Dr. V.K. Shrivastava, Professor and Head, Dept. of Entomology and Dr. U.C. Singh, Professor, Dr. N. K. S. Bhadauria, Tech. Assistant Dept. of Entomology for their continued inspiration and all possible help during the tenure of investigation.

I will ever remain grateful to Dr. Anil Kumar Singh, Hon'ble Vice Chancellor, RVSKVV, Gwalior; Dr. B.S. Baghel, Dean Faculty of Agriculture, RVSKVV, Gwalior, Dr. R.L. Rajput, Director Instruction, RVSKVV, Gwalior; Dr. H.S. Mehar, Registrar, RVSKVV, Gwalior; and Dr. S.S. Tomar, Dean, College of Agriculture, Gwalior; for providing necessary facilities for conducting research experiment.

I am thankful to Sh. Rajendra Dhamdhere, Sh. Sunil Sisodiya, Smt. Gomti bai, Peon, Mr. Avneesh Bhadauria and Deepak Kushwah for their cooperation during the research work.

I pay a lot of Thanks to my friends, Manoj Parmar, Satayam Mandloi, Dheeraj Kumar Verma, Hariom Singh Yadav, Shalini Goutam, N manoj, Nilesh Dhanoliya and Raghunandan Bairagi.

At last, I don't have words to express my heartful gratitude towards my father Shri K.S. Thanna, Mother (Smt.) Geeta Thanna, elder brother Deepak Thanna & Bhabhi Smt. Tara Thanna, loving nephew Dakshya, my wife Smt. Anita Thanna for their unceasing and moral support throughout my study. Also, my all family whose love, devotion and blessing have made my education possible.

Place : Gwalior
Date : ……..

Kanhaiyalal Thanna

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CHAPTER- I

INTRODUCTION

Soybean is an important oil seed legume crop in the world. It contains about 20 per cent oil and 42 per cent protein, which has 2-3 times more protein yield per hectare than other legumes. Besides having such nutritive value and being a leguminous crop, it is capable of fixing atmospheric nitrogen at the rate of 85-115 kg/ha (Alexander, 1977) with symbiosis of *Rhizobium japonicum* micro-organism after fulfillment of its requirement.

Soybean has shown tremendous growth in area and production in the country and in Madhya Pradesh, particularly during recent past. This crop has emerged as one of the prominent rainy season crop in central India and most important oilseed crop next to mustard and groundnut in India. Its cultivation is leaping down southwards in the state of Maharashtra, Karnataka and Tamil Nadu, as well as in the eastern states apart from part of Uttar Pradesh and Rajasthan adjoining to Madhya Pradesh. Having approximately 80 per cent share in national area and production of soybean, Madhya Pradesh has distinguished as ‘soya-state’. Now this crop has occupied a vital place in agricultural and oil economy of India.

It has been experienced that in last 4-5 years the soybean crop is facing various challenges and loosing its attraction among the farmers because of reduced yield. Among the various factor responsible for the low yield, the insect pests have been considered to be of prime importance. Singh and Verma (1992) reported 150 insect pests damaging soybean in M.P. and about a dozen of them have been reported causing serious damage to soybean from sowing to harvesting.

Among the pest, Bihar hairy caterpillar, *Spilosoma obliqua* Walker (Lepidoptera: Arectiidae), is one of the most important defoliator pest of Soybean [*Glycine max* (L.) Merr.] in India. Neonate larvae are gregarious in habit and feed on the green matter underside of leaves. The later instar larvae disperse and voraciously defoliate the leaves causing serious damage to the crop. The reaction of host plants except sesame

on growth parameters of *S. obliqua* has been reported by Deshmukh et al. (1982), Prasad and Chand (1980a, 1980b), Chand (1979) and Katiyar et al. (1976). No attempt has been made so far to study the preference and consumability of the *S. obliqua* on different varieties of soybean.

Therefore the present investigation was conducted with following objectives:

1. To study the influence of varieties on consumability of the leaves by the larva of *Spilosoma obliqua* (Walker).
2. To study the influence of varieties on growth and development of *S. obliqua*.
3. To select out the most effective plant extract against *S. obliqua.*

CHAPTER - II
REVIEW OF LITERATURE

The available literature on the reaction of varieties and efficiency of plant extract against bihar hairy caterpillar (*Spilosoma obliqua)* and some other lepidopteran pests are reviewed here with.

(A) Reaction of soybean varieties to *S. obliqua*.

Ram *et al.* (1989) reported that during the rainy season of 1988, *S. obliqua* infestation in soybean crops was very severe. Infestation during initial podding of late-sown plants resulted in yield losses of about 80%, whereas infestation at an advanced stage (normal-sown plants) resulted in satisfactory seed development but a reduction in seed size by about 40%. *G. soja* planted in a hybridization block remained completely free from *S. obliqua*. Breeding line PK515 with *G. soja* in its parentage was only partially damaged and could be easily identified in the field. Also, a few narrow leaf plants with negligible infestation were observed in the F2 generation of the cross *G. soja* X PK472. The soybean line PK564 from the cross (UPSM534 X S38) X Bragg also showed moderate resistance.

Prasad *et al.* (1989) conducted field experiments in Kanke, India, during the wet season of 1984 to study the effect of 16 maize/soyabean intercropping systems on the extent of damage to soyabeans caused by *Spilosoma obliqua*. Least damage was recorded in soyabean grown between paired rows of maize (0.64 and 24.35% damaged plants after 35 and 65 days, resp.). Fertilizer levels also influenced the extent of insect damage, high fertilizer levels resulting in significantly greater damage (4.18 and 34.06% with 100% fertilizer after 35 and 65 days, resp.).

Neupane (1991) tested four soyabean genotypes, PI 226787, PI 229358, Davis and Hardee,for their antixenosis and antibiosis to newly-emerged larvae of *Spilarctia casigneta [Spilosoma casigneta]* in the laboratory at 32°C and LD 14:10. PI 227687 and PI 229358 showed the greatest antixenosis and strong antibiosis (high larval and pupal mortalities, reduced pupal weight, and a low growth index). Davis and Hardee

were the favoured hosts as indicated by high larval preference based on increased feeding and low larval and pupal mortalities, increased pupal weight and a high growth index.

Bhadauria *et al.* (1998) tested Reaction of fifteen soybean varieties against Bihar hairy caterpillar, *Spilosoma obliqua.*Fortheir relative resistance Based on leaf area consumed, Nonpreference was reported in NRC 12, NRC 7 and Bragg, while NRC 7 showed antibiosis.

Bhadauria *et al.* (1999) evaluated seventeen sesame cultivars under laboratory to study their reaction to the bihar hairy cateepillar (*Spilosoma oblique*). Significaent difference among varieties were found for leaf area, biomass consumed and larval weight cultivar RAUSS-17-4 was less preferred for feeding and may be considered more resistant to *S. obliqua.*

Shrivastava *et al.* (*1999)* tested feeding potential of Bihar hairy caterpillar, *Spilosoma obliqua* Walker on soybean. JS 335 revealed that larvae consumed 467.469+or-46.232 cm2 leaf area, weighing 5.954+or-0.056 g during its developmental period from second instar onwards. Approximately 92.34% of the feeding occurred in the later two instars. Consumption was estimated to be 4.474 leaves per larva.

Taware *et al.* (2007) evaluated 19 soyabean (G. max) lines for resistance to stem fly (M. sojae), Bihar hairy caterpillar *(Spilarctia obliqua*) and tobacco caterpillar *(Spodoptera litura).* Based on pooled data on per cent stem tunnelling by stem fly, 10 lines were found to be resistant. Three lines, i.e. MAUS 30, PK 1347 and NRC 59 were resistant to Bihar hairy caterpillar. No line was resistant to tobacco caterpillar, but 10 lines showed moderate resistance to this pest. NRC 51 and NRC 52 were highly resistant to stem fly, and moderately resistant to Bihar hairy caterpillar and tobacco caterpillar.

Harish *et al*. (2009) Evaluated 11 soyabean genotypes (DSb-1, Bragg, PK 1029, JS 93-05, KHSb-2, MRSB-342, DSb 6-1, Monetta, MACS-450, NRC-67 and JS-335) against major defoliator pests *(Spodoptera litura, Thysanoplusia orichalcea, Spilarctia obliqua and Helicoverpa armigera).* The lowest percentage of defoliation was

observed in KHSb-2 (14.33%), followed by DSb-1 (21.33%). KHSb-2, DSb-1 and Bragg were categorized as highly resistant, whereas PK1029, NRC-67, MACS-450 and MRSB-342 were classified as moderately resistant. DSb-6-1 and JS 93-05 were susceptible, and JS 335 and Monetta were highly susceptible. Percent pod damage was lowest in Monetta (20.75%), JS 93-05 (21.21%), DSb-1 (26.41%), PK 1029 (26.67%) and KHSb-2 (27.82%), which were on a par with the control JS 335 (17.68%). JS-335, Monetta and JS 93-05 were highly resistant, whereas DSb-1, PK1029, KHSb-2 and NRC-67 were moderately resistant. DSb 6-1, MACS-450, Bragg and MRSB-342 were highly susceptible. The percentage of yield loss due to the insect pest complex ranged from 19.61(DSb-1) to 36.37% (NRC-67). Using the maximin-minimax method, JS 335, DSb-1, PK1029, JS 93-05, Monetta and Bragg were classified as susceptible but high-yielding (i.e. tolerant of the insect pest complex), whereas the other genotypes were susceptible and low-yielding.

(B) Efficacy of different plant extracts against *S. obliqua*.

Chaudhary (1992) reported that *Dhatura alba* and *Azadirachta indica* gives 90 per cent and 73.3 per cent mortality, respectively as against 13.3 per cent in control against larvae of *Plecoptera refiex*.

Babu *et al.* (1996) reported that Azadirachtin signifcantly inhibited feeding, food consumption and larval growth in a concentration dependent manner. The dietary utilization was decreased and the approximate digestility of food was increased at higher concentration of Azadirachtin.

Sudharajan (2001) evaluated the effect of leaf methanolic extracts of 5 indignous plant materials namely *Abutilon indicum, Achyranthus aspera, Ailernthus excelsa, Alstonia venenta* and *Azinia teracantha* against *Helicoverpa armigera* and repoted larval mortality To be 51, 58, 62, 67 and 73 per cent on tomto leaves treated with *Azinia tetracantha, Achyranthus aspera, abutilon indicum, Ailernthus excelsa* and *Alstonia venenta* respectively.

Rathore (2003) reported neeem seed kernal to be most effctive with regards to larval mortality and larval weight followed by harsingar, biskhapara and chinese glory.

Gautam *et al.* (2003) examined methanol extracts of 24 species of family asteraceae for thier insecticidal activity against Spilosoma obliqua walk. On the basis of mortality count of insect, extracts of *Saussurea heteromala,Cichorium intybus* and *Verhoina cinerea* were effective against Spilosoma obliqua.

Mandal and Bhattacharya (2003) studied the effect of Azadirachtain (Az) on *Spilosoma oblique* and antifeedant action of Azadirachtain against 12 days old larvae. However, this property gradually decreased with the advancement of larval stage, and development of neonate of Azadirachtain showed that performance of growth parameters decreased with the increasing of concentration. However diet fortified with 0.500 ppm resulted in complete larval mortality.

Chahal *et al.* (2003) laboratory experiment conducted to determine the efficacy of new *Bacillus thuringiensis* isolates and leaf extracts of *Parthenium hysterophorus, Calotropis prosera* and *Azadirachtain indica* on Bihar hairy caterpillar (*S. obliqua*). The *B.thuringiensis* isolates and leaf extract of *P. hysterophorus, Calotropis prosera* and *Azadirachtain indica* showed 100, 60, 50 and 70% larval mortality, respectively, within 24-48 h of feeding.

Bajpai and Sehgal (2003) studied the treatment of diets with benzene extract (BE) 0.2 cloroform extract (CE), 0.05 to 0.1% ethyl acetet (EAE) methanol extract (ME) and butanol extract (BE), 0.05 to 0.2% Neem seed kernel water extract (NSKWE) 6 to 10%. Green mark and neem guard 0.4 to 0.8 per cent, Neem oil 2 to 6 per cent, karanj oil 6% and nicotine sulphate, 0.3 to 0.04 per cent resulted in 100% larval mortality in different developmental period indicating zero success index. The maximum larval duration 28.9 days with minimum pupal weight, 0.568 g was observed on diets treated with BE 0.15 per cent, ECE, ME and BE at 0.025% NSKWE 4 per cent, and nicotine sulphate 0.23 per cent resulted in 100 per cent pupal mortility. The treatment of diets with BE, 0.05 and 1 %, NSKWE 2%, Green mark and neem guard 0.2%, neem oil 0.5%, karanj oil 2% and nicotine sulphate 0.1% gave 100% abnormal pupae with could not emerge.

Tandaon *et al.* (2004) evaluated essential oil of *Elsholtzia densa* as an IGR against Bihar hairy caterpillar, *Spilosoma obliqua* (Walk.) and reported to be promising

in cousing adverse morphogenic effect on various other biological parameters including reproducation of *S.obliqua.*

Dubey *et al.* (2004) tested thirteen plant extract against third instar larval of *Spilosoma oblique* Walk. Under laboratory and field condition and reported that 2.0%extract of *Acorus calamus, vitex negudo and Ageratum conyzoides* gave 80.87, 72.84 and 67.91% mortality to the third instar larval of *Spilosoma obliqua* Walk. In laboratory, whereas, 74.26, 68.63 and 66.20% mortality under field trials.

Massey and Mishra (2005) tested the toxicity of certain indigenous plant products against Bihar hairy caterpillar, Oral toxicity of tobacco leaf extract 3% was found maximum on the 1st instar larval of BHC, causing 100% net mortality, while NSKE 5 per cent proved to cause maximum toxicity on 3rd and 5th instar larval and giving maximum net mortality for 3rd and 5th instar as 88.89% and 57.14%, respectively.

Singh *et al.* (2005) teste the extract of three botanicals viz., Neem, Parthenium and Chinese glory prepared in water and ethanol against Bihar hairy caterpillar in the concentration of 0.25 and 0.50%. Higher and lower concentration of ethanol extract of Parthenium were found effective and showed antifeedant effect against Bihar hairy caterpillar.

Sonowal and Bhattacharya (2008) studied the insecticidal activities of acetone plant extracts at different concentrations against Bihar hairy caterpillar of jute, *S. obliqua*, under laboratory conditions. Among the 7 plant extracts evaluated, i.e. neem (*Azadirachta indica*), karanja (*Pongamia pinnata*) vasac (*Adhatoda vasica*), dalchini (*Cinnamomum zeylanicum*), Sweet flag (*Acorus calamus*) and tulsi (*Ocimum sanctum*) recorded the highest percentage of larval mortality (75.55%) at 96 h after treatment. The efficacy of bach was compared with that of commercial botanical, microbial and synthetic chemical pesticides. The synergistic association between Sweet flag and these pesticides was also evaluated. No antagonistic effect was recorded for all combinations. Sweet flag-azadirachtin combination showed considerable synergistic effect.

Chandel *et al.* (2009) treated cabbage (*Brassica oleracea* var. *capitata*) leaves with 2.0% of extract of *Adhatoda vasica*, *Alpinia galanga, Azadirachta indica, Curcuma domestica* [*Curcuma longa*] and *Cleome monophylla* to determine their efficacy against Bihar hairy caterpillar (*Spilarctia obliqua*). All treatments were superior to the untreated control. Among various treatments, *Adhatoda vasica* caused the maximum larval mortality (86.6%) after 24 h, after 48 h, *Adhatoda vasica* and *A. indica* showed 93.3% and 89.9% larval mortality, which was at par with other treatments. At 72 h after treatment, all the botanical insecticides were significantly superior to the untreated control. Efficacy of *Adhatoda vasica* caused the maximum mean mortality by recording 93.33%, which was significantly superior to *Azadirachta indica* > *Curcuma domestica* > *Cleome monophylla* > *Alpinia galanga* > the control.

Bhattacharya and Dhar (2014) studied the effects of two botanicals *viz.*, pongamia oil 60% and azadirachtin 0.03% at 4 and 5 different concentrations, respectively on 2nd instar larvae of bihar hairy caterpillar, *Spilosoma obliqua* (Walker). Attempts were also made to study the combined efficacy of microbials (*Btk*55000 SU/mg and avermectin 1.8% w/v) and botanicals against the same pest. Azadirachtin 0.03% at 6000 and 5000 ppm showed superiority over all other treatments with respect to larval mortality. Pongamia oil 60% at the highest concentration resulted in 43.3% larval mortality as compared to Azadirachtin 0.03%. Pongamia oil 60% could not show mortality of the larva at the lowest dose (1000 ppm). When the botanicals in combination with microbials were assessed, the highest mortality of 2nd instar larvae of *S. obliqua* was witnessed (95.5%) in the treatment of avermectin 1.8% w/v+azadirachtin 0.03% at 96 hours after treatment. Whereas *Btk* 55000 SU/mg+pongamia oil 60% treatment caused the least mortality of 48.9% at 96 hours after treatment. But in all the treatments with these two botanicals a gradual increase in mortality of the test insect was observed.

CHAPTER - III
MATERIAL AND METHODS

The present studies on reaction on soybean varieties and efficiency of plant extract against Bihar hairy caterpillar, *Spilosoma obliqua* (Walk.) were carried out during kharif season of 2014 -15 in the department of Entomology College of Agriculture, Gwalior with the view to select out less susceptible variety of Soybean and most effective plant extract against Bihar hairy caterpillar. The technique adopted and the material used during the course of studies were as under.

Experiment no. 1 :- Reaction of Soybean varieties against Bihar hairy caterpillar.

The ten varieties of Soybean namely JS-2070, JS-9305, Bragg, RVS-2001-18, JS-2069, NRC-94, JS-335, SL-955, RVS-2002-4 and JS-20-89 were grown in the plot with normal agronomical practices. The leaves of each variety were picked up from the field and kept in Petridis after recording their weight with the help of electronic balance. The experiment was replicated three times three first instar larvae were released in each Petridis. The observations on weight of leaves consumed in each variety was recorded at the time of changing the leaves. Fresh leaves were provided at two days interval starting from their release. Larval weight was also recorded at 2 days interval starting from their released up to formation of pupa. The data on the larval period and length of full grown larvae were recorded. Total leaves weight consumed by the larva, consumption index (C.I.) growth rate (G.R.) efficiency of conservation of ingested food (E.C.I.) and digestibility were also calculated as per method suggested by Waldbauer(1968).

$$\text{Consumption index} = \frac{\text{Food consumption}}{\text{Time} \times \text{Avarage}}$$

$$\text{Growth rate} = \frac{\text{Growth}}{\text{Time} \times \text{Avarage}}$$

$$\text{Efficiency of conservation of ingested food} = \frac{\text{Weight gained}}{\text{Weight of food ingested}} \times 100$$

$$\text{Aproximate digestibility} = \frac{\text{Weight of food ingested} - \text{Weight of feces}}{\text{Weight of food ingested}} \times 100$$

Experiment no. 2 :- Efficacy of plant extract against bihar hairy caterpillar.

Treatment:- (7 plant extract + control (water treated)

The plant material of seven plants (Table 3.1) were collected locally and dried at room temperature. The dried plant materials were grinded to make their powder. five per cent solution of each plant material was used for treting the leaves.

Table 3.1 List of plants and their plant part used.

S.NO.	English Name	Botanical name	Family	Plant part used for extract
1	Margosa (Neem)	*Azadirachta indica*	Meliaceae	Leaves
2	Datura	*Datura fastuosa*	Solanaceae	Fruits
3	Parthenium	*Parthenium hysterophorus*	Asteraceae	Leaves
4	Garlic	*Alium sativum*	Alliaceae	Bulbs
5	Tulsi	*Ocimum tenuflorum*	Lamiaceae	Leaves
6	Oak (Madar)	*Colotropis gegentea*	Fagaceae	Leaves
7	Green Chilli Fruit	*Capsicum annum*	Solanaceae	Fruits

Treated leaves were kept in Petridishes after taking the weight of leaves and five larvae of second instar were released in each Petridish after taking the weight of each larva. Experiment was replicated three times. Treated leaves were changed at two days interval starting from the release of larvae. At the time of changing the leaves, observation were recorded on weight of leaves consumed by the larvae in different treatments. Data on larval mortality was recorded upto 10 days after release The data of percentage were subjected to angular (arc sin) transformation for statistical analysis.

CHAPTER - IV

RESULTS

Present investigation on the reaction of Soybean varieties and efficacy of plant extract against bihar hairy caterpillar, *Spilosoma obliqua* (walk.) were determined on the basis of leaves weight consumed and its effect on growth and development. The results so obtained are described here with.

(A) Reaction of Soybean varieties to *S. obliqua*.

(i) effect of varieties on leaf consumption.

The data recorded on leaf weight consumed by larvae at different days after release of *S. obliqua* are given in Table 4.1.

At 2 days after release consumption of leaves was significantly influenced by different varieties. Minimum consumption of leaves (0.166 g) was recorded in variety Bragg which found significantly less than rest of the varieties except NRC-94, RVS-2002-4 and JS-20-89, Whereas, maximum consumption of leaves (0.357 g) was recorded in variety RVS -2001-18 which found significantly higher than rest of the varieties except JS – 20-71, JS-335 and SL-955.

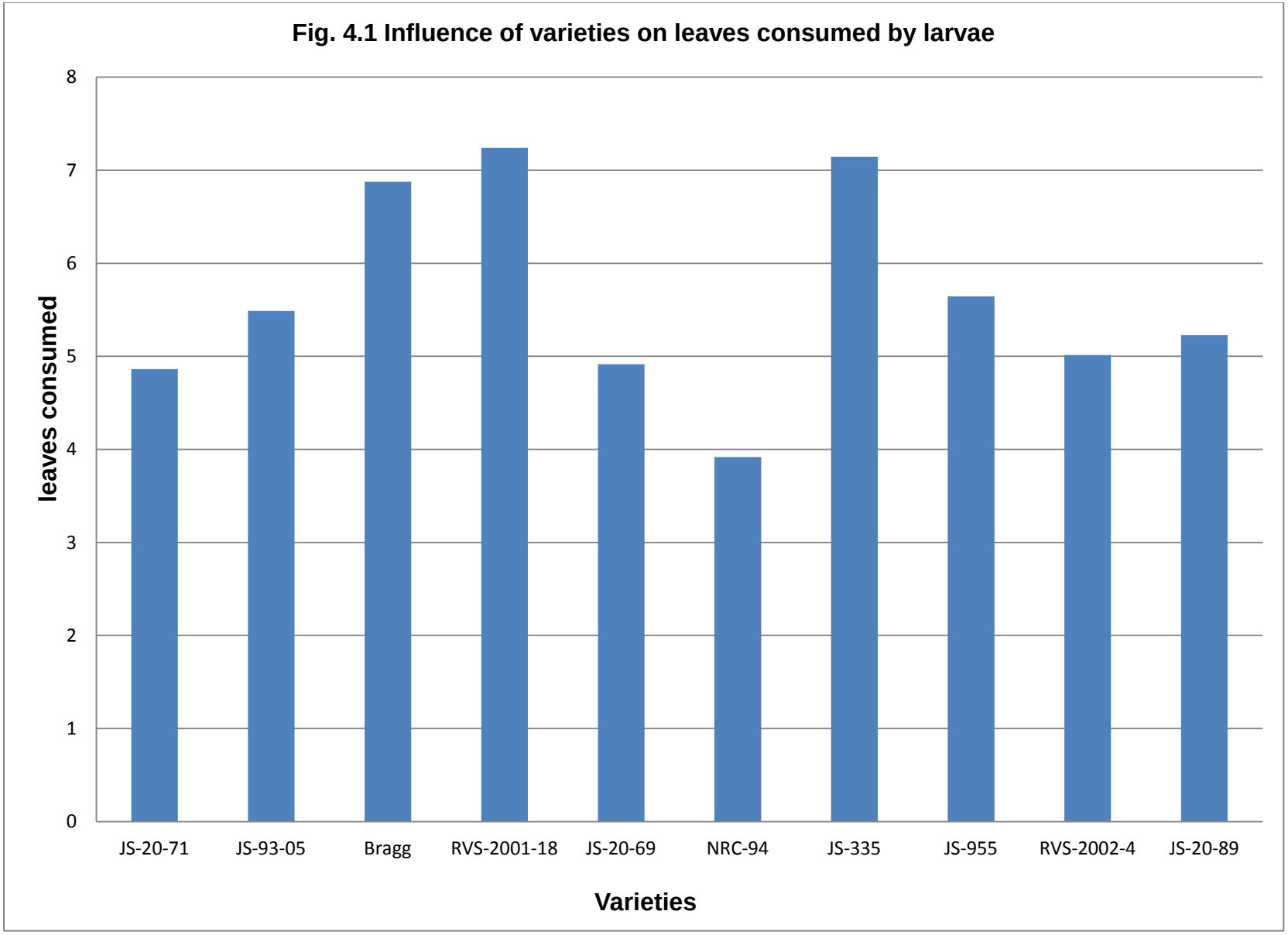
At 4 days after release consumption of leaves was significantly influenced by different varieties. Minimum consumption of leaves (0.402 g) was recorded in variety RVS-2002-4 which found significantly less than rest of the varieties except NRC-94, and JS-20-89, Whereas, maximum consumption of leaves (0.794 g) was recorded in variety RVS -2001-18 which found significantly higher than rest of the varieties except JS-93-05, JS-335 and SL-955.

At 6 days after release consumption of leaves was significantly influenced by different varieties. Minimum consumption of leaves (0.788 g) was recorded in variety JS-20-89 which found significantly less than rest of the varieties except JS-93-05, JS – 20-69 NRC-94 and RVS-2002-4, whereas, maximum and significantly higher consumption of leaves (1.431 g) was recorded in variety JS-335 as compared to rest of the variety.

Table 4.1 : Effect of varieties on leaves consumption by *S. obliqua.*

S. No.	Varieties	Weight of leaves consume (g) by larvae at Days after release.									
		2	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**
1.	JS-20-71	0.294	0.650	1.063	1.485	1.985	2.387	2.971	3.527	4.266	4.862
2.	JS-93-05	0.233	0.685	0.872	1.252	1.668	1.963	2.963	3.713	4.855	5.488
3.	Bragg	0.166	0.591	1.134	1.646	2.143	2.762	4.335	5.169	5.896	6.878
4.	RVS-2001-18	0.357	0.794	1.238	1.643	2.342	2.928	3.871	4.835	6.031	7.243
5.	JS-20-69	0.227	0.535	0.873	1.349	1.757	2.029	2.645	3.447	4.411	4.916
6.	NRC-94	0.219	0.504	0.885	1.175	1.455	1.717	2.146	2.709	3.243	3.918
7.	JS-335	0.354	0.773	1.431	1.896	2.637	3.171	4.622	5.534	6.395	7.142
8.	SL-955	0.353	0.697	1.002	1.262	2.020	2.241	2.864	3.800	4.876	5.644
9.	RVS-2002-4	0.186	0.402	0.891	1.332	1.552	1.706	2.135	3.347	4.257	5.013
10.	JS-20-89	0.168	0.475	0.788	1.199	1.744	2.075	2.932	3.710	4.590	5.228
	S.Em (±)	**0.037**	**0.042**	**0.059**	**0.074**	**0.094**	**0.085**	**0.129**	**0.175**	**0.243**	**0.317**
	CD at 5%	**0.109**	**0.125**	**0.177**	**0.220**	**0.280**	**0.253**	**0.384**	**0.520**	**0.721**	**0.942**

Fig. 4.1 Influence of varieties on leaves consumed by larvae



At 8 days after release consumption of leaves was significantly influenced by different varieties. Minimum consumption of leaves (1.175 g) was recorded in variety NRC-94 which found significantly less than rest of the varieties except JS-93-05, SL-955, RVS-2002-4 and JS-20-89, Whereas, maximum and significantly higher consumption of leaves (1.896 g) was recorded in variety JS-335 as compared to rest of the varieties.

At 10 days after release consumption of leaves was significantly influenced by different varieties. Minimum consumption of leaves (1.455 g) was recorded in variety NRC-94 which found significantly less than rest of the varieties except JS-93-05, and RVS-2002-4. Whereas, maximum and significantly higher consumption of leaves (2.637 g) was recorded in variety JS-335 as compared to rest of the varieties.

At 12 days after release consumption of leaves was significantly influenced by different varieties. Minimum consumption of leaves (1.706 g) was recorded in variety RVS-2002-4 which found significantly less than rest of the varieties except NRC-94, whereas maximum and significantly higher consumption of leaves (3.171 g) was recorded in variety JS-335 as compared to rest of the varieties.

At 14 days after release consumption of leaves was significantly influenced by different varieties. Minimum consumption of leaves (2.135 g) was recorded in variety RVS-2002-4 which found significantly less than rest of the varieties except NRC-94 .Whereas maximum and significantly higher consumption of leaves (4.622 g) was recorded in variety JS-335 as compared to rest of the varieties.

At 16 days after release consumption of leaves was significantly influenced by different varieties. Minimum consumption of leaves (2.709 g) was recorded in variety NRC-94 which found significantly less than rest of the varieties. Whereas, maximum and significantly higher consumption of leaves (5.534 g) was recorded in variety JS-335 as compared to rest of the varieties except Bragg.

At 18 days after release consumption of leaves was significantly influenced by different varieties. Minimum consumption of leaves (3.243 g) was recorded in variety NRC-94 which found significantly less than rest of the varieties. Whereas, maximum consumption of leaves (6.395 g) was recorded in variety JS-335 which was significantly as compared to rest of the varieties except Bragg and RVS -2001-18.

At 20 days after release consumption of leaves was significantly influenced by different varieties. Minimum consumption of leaves (3.918 g) was recorded in variety NRC-94 which found significantly less than rest of the varieties except JS-20-71 and JS-20-69. Whereas, maximum consumption of leaves (7.243 g) was recorded in variety RVS -2001-18 which was significantly than rest of the varieties except Bragg and JS-335.

(ii) Influence of varieties on larval weight

Weight of larvae fed on different varieties was taken at different days after release and obtained data are presented in Table 4.2.

The weight of 2 days old larvae was significantly influenced by different varieties. Minimum larval weight (.029 g) was recorded in variety JS-20-71 which found significantly less than rest of the varieties except JS-93-05, RVS-2001-18, JS-20-69, NRC-94, JS-335, SL-955, RVS-2002-4and JS-20-89. Whereas, maximum and significantly higher larval weight (0.297 g) was recorded in variety Bragg than rest of the variety.

Observation recorded at 4 days after release showed that the tested varieties influence the larval weight significantly minimum larval weight (0.044 g) was recorded in variety JS-20-71 which found significantly less than rest of the varieties except JS-93-05, RVS-2001-18, JS-20-69, NRC-94, JS-335, SL-955, RVS-2002-4 and JS-20-89, Whereas, maximum and significantly higher larval weight (0.353 g) was recorded in variety Bragg than rest of the variety.

Observation recorded at 6 days after release showed that the tested varieties influence the larval weight significantly minimum larval weight (0.080 g) was recorded in variety JS-20-71 which found significantly less than rest of the varieties except JS-93-05, RVS-2001-18, JS-20-69, NRC-94, SL-955, RVS-2002-4 and JS-20-89. Whereas, maximum and significantly higher larval weight (0.383 g) was recorded in variety Bragg than rest of the variety.

Table 4.2 : Effect of varieties on larval weight of *S. obliqua.*

S. No.	Varieties	Larval weight (g) days after release									
		2	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**
1.	JS-20-71	0.029	0.044	0.08	0.105	0.115	0.198	0.259	0.332	0.412	0.498
2.	JS-93-05	0.041	0.091	0.105	0.145	0.183	0.251	0.354	0.464	0.638	0.745
3.	Bragg	0.297	0.353	0.383	0.332	0.429	0.501	0.546	0.671	0.877	1.039
4.	RVS-2001-18	0.034	0.058	0.083	0.132	0.228	0.285	0.432	0.524	0.880	1.041
5.	JS-20-69	0.030	0.053	0.065	0.125	0.169	0.215	0.291	0.349	0.505	0.617
6.	NRC-94	0.077	0.045	0.065	0.086	0.126	0.186	0.281	0.375	0.534	0.635
7.	JS-335	0.098	0.074	0.183	0.238	0.359	0.473	0.651	0.954	1.166	1.311
8.	SL-955	0.137	0.092	0.132	0.164	0.261	0.328	0.543	0.513	0.737	0.845
9.	RVS-2002-4	0.057	0.044	0.065	0.139	0.207	0.267	0.315	0.460	0.609	0.744
10.	JS-20-89	0.076	0.051	0.062	0.113	0.165	0.233	0.332	0.540	0.710	0.858
	S.Em (±)	**0.039**	**0.041**	**0.083**	**0.034**	**0.040**	**0.042**	**0.048**	**0.048**	**0.069**	**0.070**
	CD at 5%	**0.110**	**0.121**	**0.114**	**0.100**	**0.119**	**0.125**	**0.142**	**0.142**	**0.204**	**0.207**

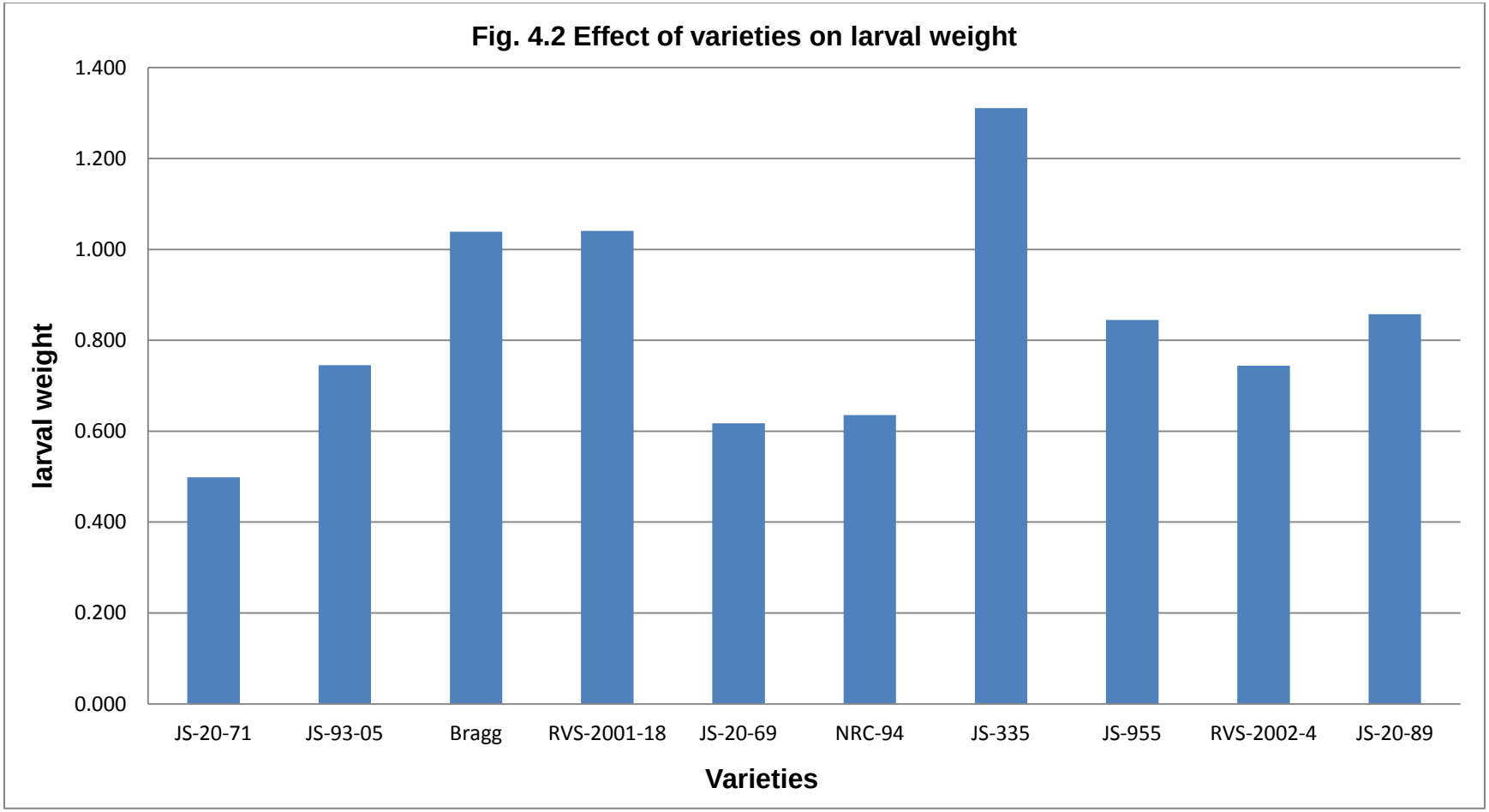


Fig. 4.2 Effect of varieties on larval weight
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
larval weight
JS-20-71
JS-93-05
Bragg
RVS-2001-18
JS-20-69
NRC-94
JS-335
JS-955
RVS-2002-4
JS-20-89
Varieties

Observation recorded at 8 days after release showed that the tested varieties influence the larval weight significantly minimum larval weight (0.086 g) was recorded in variety NRC-94 which found significantly less than rest of the varieties except JS-20-71, JS-93-05, RVS-2001-18, JS-20-69, SL-955, RVS-2002-4 and JS-20-89. Whereas, maximum and significantly higher larval weight (0.390 g) was recorded in variety Bragg than rest of the varieties except varieties JS-335.

Observation recorded at 10 days after release showed that the tested varieties influence the larval weight significantly minimum larval weight (0.115 g) was recorded in variety JS-20-71 which found significantly less than rest of the varieties except JS-93-05, RVS-2001-18, JS-20-69, NRC-94, RVS-2002-4 and JS-20-89, Whereas, maximum larval weight (0.429 g) was recorded in variety Bragg, which found significantly higher than rest of the varieties except JS-335.

Observation recorded at 12 days after release showed that the tested varieties influence the larval weight significantly minimum larval weight (0.186 g) was recorded in variety NRC-94 which found significantly less than rest of the varieties except JS-20-71, JS-93-05, RVS-2001-18, JS-20-69, RVS-2002-4 and JS-20-89, Whereas, maximum larval weight (0.501 g) was recorded in variety Bragg, which found significantly higher than rest of the varieties except JS-335.

Observation recorded at 14 days after release showed that the tested varieties influence the larval weight significantly minimum larval weight (0.259 g) was recorded in variety JS-20-71 which found significantly less than rest of the varieties except JS-93-05, JS-20-69, NRC-94, RVS-2002-4 and JS-20-89, Whereas, maximum larval weight (0.651 g) was recorded in variety JS-335, which found significantly higher than rest of the varieties except Bragg, SL-955.

Observation recorded at 16 days after release showed that the tested varieties influence the larval weight significantly minimum larval weight (0.332 g) was recorded in variety JS-20-71 which found significantly less than rest of the varieties except JS-93-05, JS-20-69, NRC-94, RVS-2002-4 and JS-20-89. Whereas, maximum and significantly higher larval weight (0.954 g) was recorded in variety JS-335 than rest of the varieties.

Observation recorded at 18 days after release showed that the tested varieties influence the larval weight significantly minimum larval weight (0.412 g) was recorded in variety JS-20-71 which found significantly less than rest of the varieties except JS-20-69, NRC-94, and RVS-2002-4. Whereas, maximum and significantly higher larval weight (1.166 g) was recorded in variety JS-335 than rest of the varieties.

Observation recorded at 20 days after release showed that the tested varieties influence the larval weight significantly minimum larval weight (0.498 g) was recorded in variety JS-20-71 which found significantly less than rest of the varieties except JS-20-69 and NRC-94. Whereas, maximum and significantly higher larval weight (1.311 g) was recorded in variety JS-335 than rest of the varieties.

(iii) Influence of varieties on the larval period

The larval period of larvae fed on the different varieties of soybean was differed significantly (Table 4.3). The maximum larval period (20.98 days) was recorded in variety RVS-2002-4 which found significantly higher than rest of the varieties except JS-20-71, Bragg, JS-20-69, and JS-20-89. Whereas the minimum larval period (17.31 days) was recorded in variety RVS-2001-18 which found significantly less than rest of varieties except SL-955.

Table 4.3 : Influence of different varieties on the larval period.

S. No.	Varieties	Larval period (days)
1.	JS-20-71	20.48
2.	JS-93-05	19.16
3.	Bragg	20.43
4.	RVS-2001-18	17.31
5.	JS-20-69	19.94
6.	NRC-94	20.98
7.	JS-335	19.96
8.	SL-955	18.13
9.	RVS-2002-4	20.89
10.	JS-20-89	19.60
	S.Em (±)	**0.612**
	CD at 5%	**1.819**

(iv) Influence of varieties on larval length

The length of larvae fed on the different varieties of soybean was differed significantly (Table 4.4). The minimum length of larvae (29.34 mm) was recorded in variety NRC-94 which found significantly less than rest of the varieties except JS-20-71, Bragg, JS-20-69, and RVS-2002-4. On the other hand maximum length of larvae (41.13 mm) was recorded in variety RVS-2001-18 which found significantly higher than rest of the varieties except SL-955.

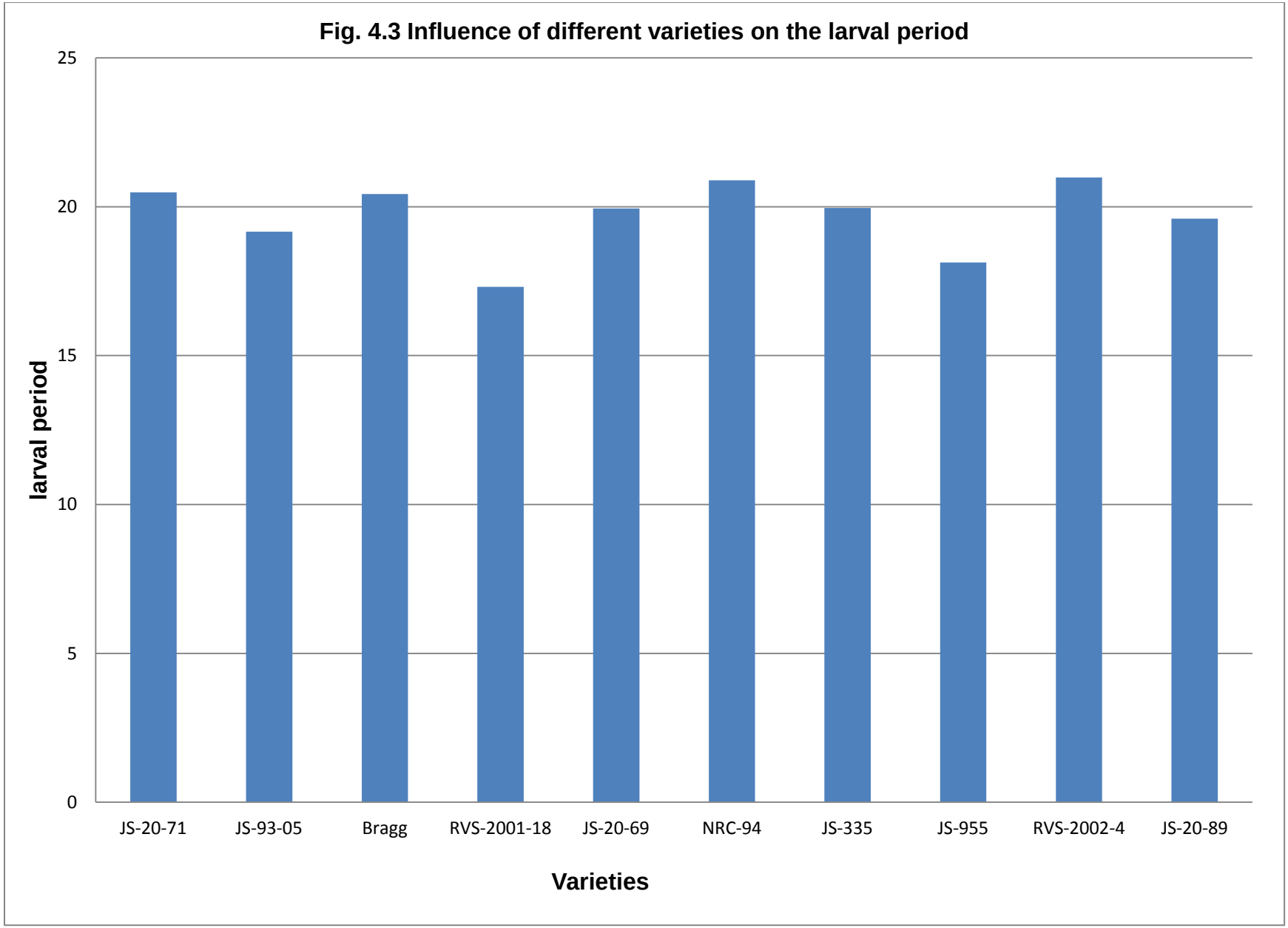


Fig. 4.3 Influence of different varieties on the larval period
25
20
15
10
5
0
larval period
JS-20-71
JS-93-05
Bragg
RVS-2001-18
JS-20-69
NRC-94
JS-335
JS-955
RVS-2002-4
JS-20-89
Varieties

Table 4.4 : Influence of varieties on length of larva of *S. obliqua*.

S. No.	Varieties	Length of larvae (mm)
1.	JS-20-71	31.45
2.	JS-93-05	34.86
3.	Bragg	31.14
4.	RVS-2001-18	41.13
5.	JS-20-69	32.42
6.	NRC-94	29.34
7.	JS-335	33.96
8.	SL-955	37.42
9.	RVS-2002-4	32.15
10.	JS-20-89	35.22
	S.Em (±)	**1.369**
	CD at 5%	**4.061**

(v) Influence of varieties on consumption index

The data recorded on consumption index of the larva reared on different varieties showed significant differences among different varieties (Table 4.5). Minimum consumption index (0.0387) was recorded on variety NRC-94 which found significantly less than rest of the varieties, except JS-93-05, JS-20-69, SL-955, RVS-2002-4 and JS-20-89. Whereas, maximum consumption index (0.0715) was recorded on variety RVS-2001-18 which found significantly higher than rest of the varieties except Bragg and JS-335.

Fig. 4.4 Influence of varieties on length of larva

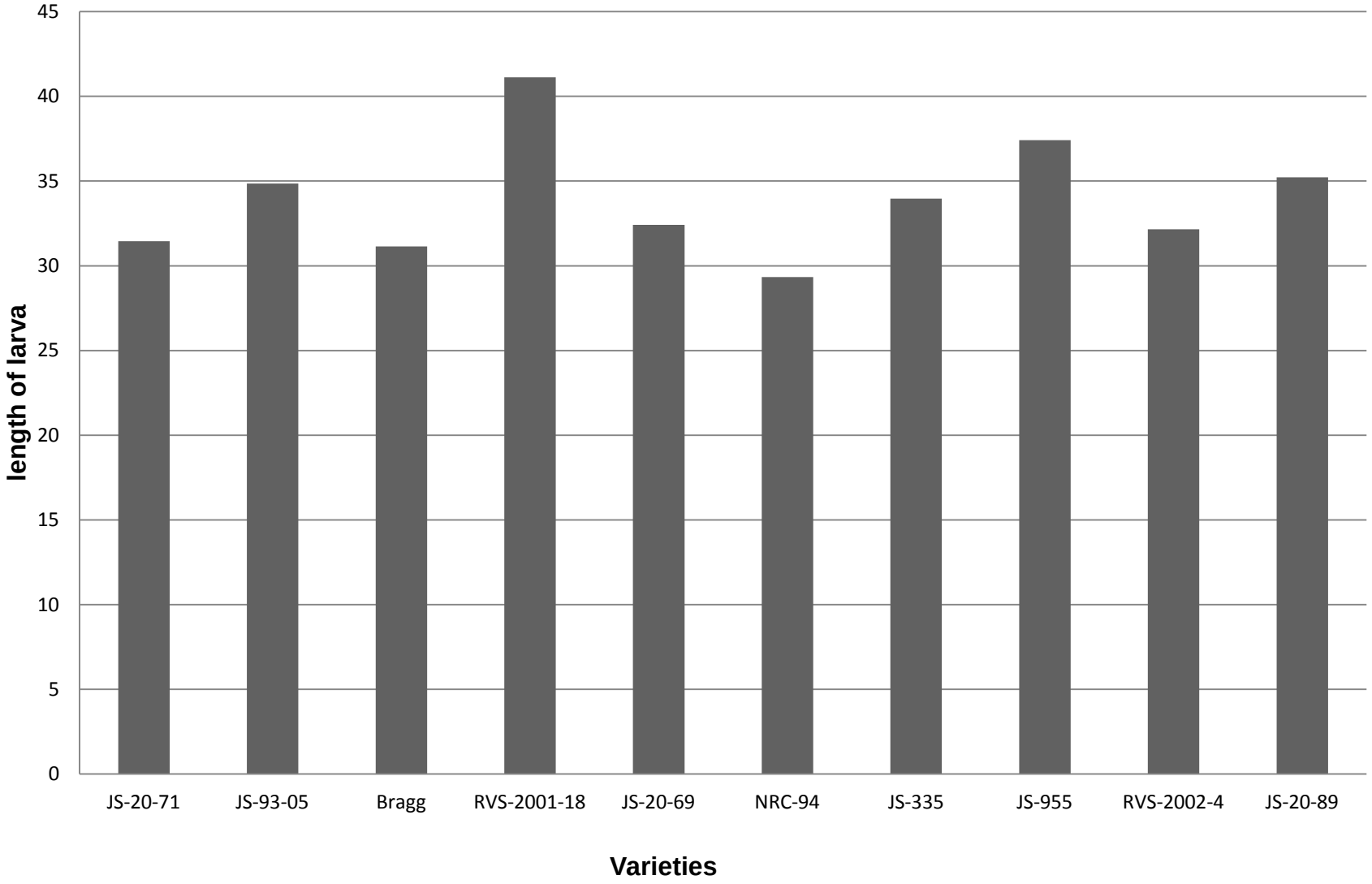


Table 4.5 : Influence of varieties on consumption index (C.I.).

S. No.	Varieties	Consumption index
1.	JS-20-71	0.0480
2.	JS-93-05	0.0541
3.	Bragg	0.0679
4.	RVS-2001-18	0.0715
5.	JS-20-69	0.0486
6.	NRC-94	0.0387
7.	JS-335	0.0705
8.	SL-955	0.0557
9.	RVS-2002-4	0.0495
10.	JS-20-89	0.0516
	S.Em (±)	**0.003**
	CD at 5%	**0.009**

(vi) Influence of varieties on growth rate

The data recorded on the growth rate of larvae reared on different varieties showed significant influence of the varieties on growth rate of *S. obliqua* (Table 4.6). Minimum and significantly less growth rate of the larvae (0.0353) was recorded on variety JS-20-71 than rest of the variety except JS-93-05, Bragg, JS-20-69, NRC-94, SL-955 and RVS-2002-4. On the other hand maximum growth rate (0.090) was recorded on variety JS-335 which was significantly higher than rest of varieties except RVS-2001-18.

Fig. 4.5 Influence of varieties on consumption index

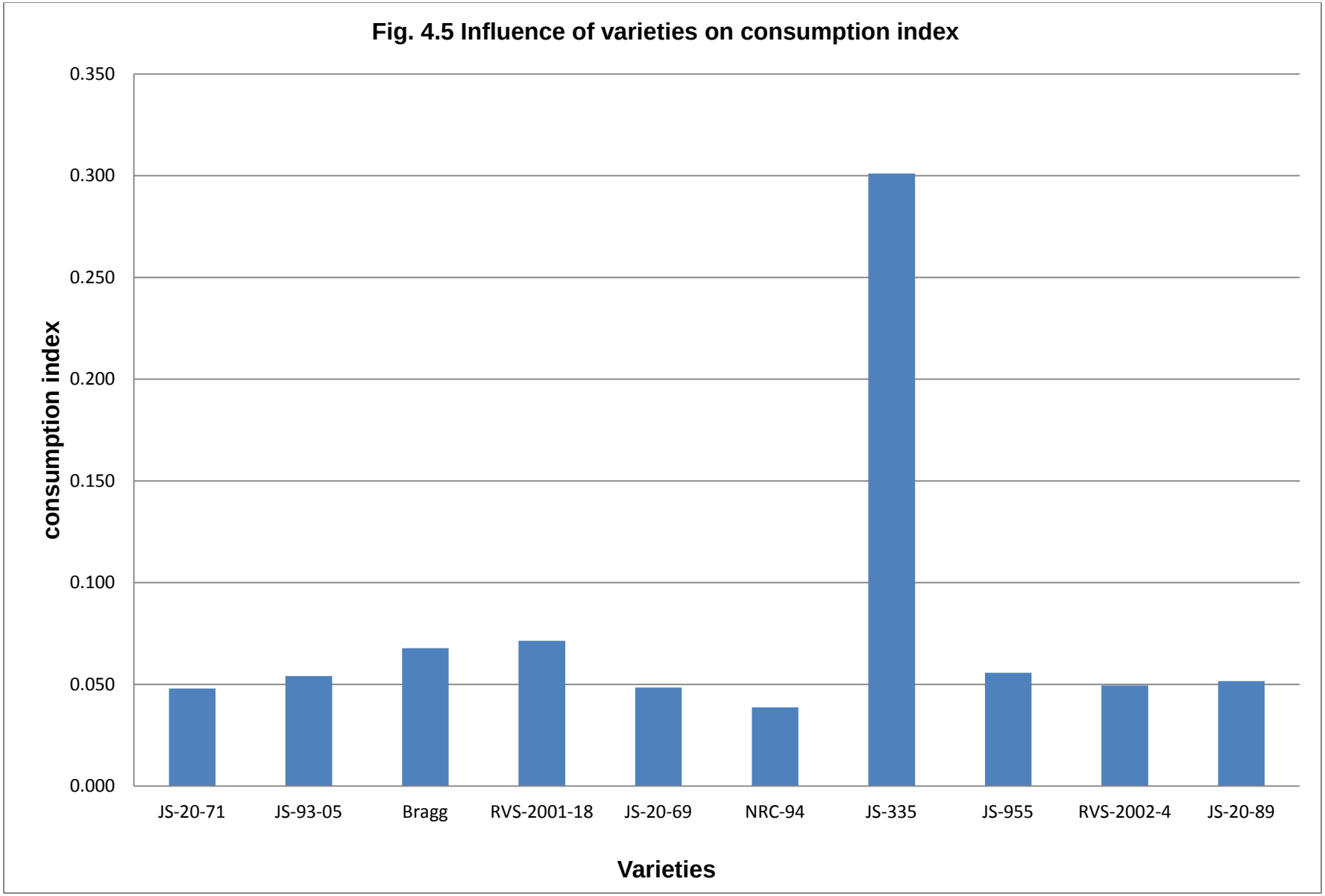


Table 4.6 : Influence of varieties on growth rate of *S. obliqua* larvae.

S. No.	Varieties	Growth rate (g/days)
1.	JS-20-71	0.035
2.	JS-93-05	0.051
3.	Bragg	0.053
4.	RVS-2001-18	0.072
5.	JS-20-69	0.042
6.	NRC-94	0.043
7.	JS-335	0.090
8.	SL-955	0.056
9.	RVS-2002-4	0.055
10.	JS-20-89	0.049
	S.Em (±)	**0.008**
	CD at 5%	**0.022**

(vii) Influence of varieties on efficiency of conversion of ingested food

Observations computed on efficiency of conversion of ingested food (E.C.I.) showed the significant influence of varieties against *S.obliqua* (Table 4.7). Minimum E.C.I. (8.67) was recorded on variety JS-20-71 which was significantly higher than rest of the varieties except JS-93-05, JS-20-69, NRC-94 and RVS-2002-4. Whereas maximum E.C.I. (23.05) was recorded on variety JS-335 which was significantly higher than varieties except RVS-2001-18.

Fig. 4.6 Influence of varieties on growth rate

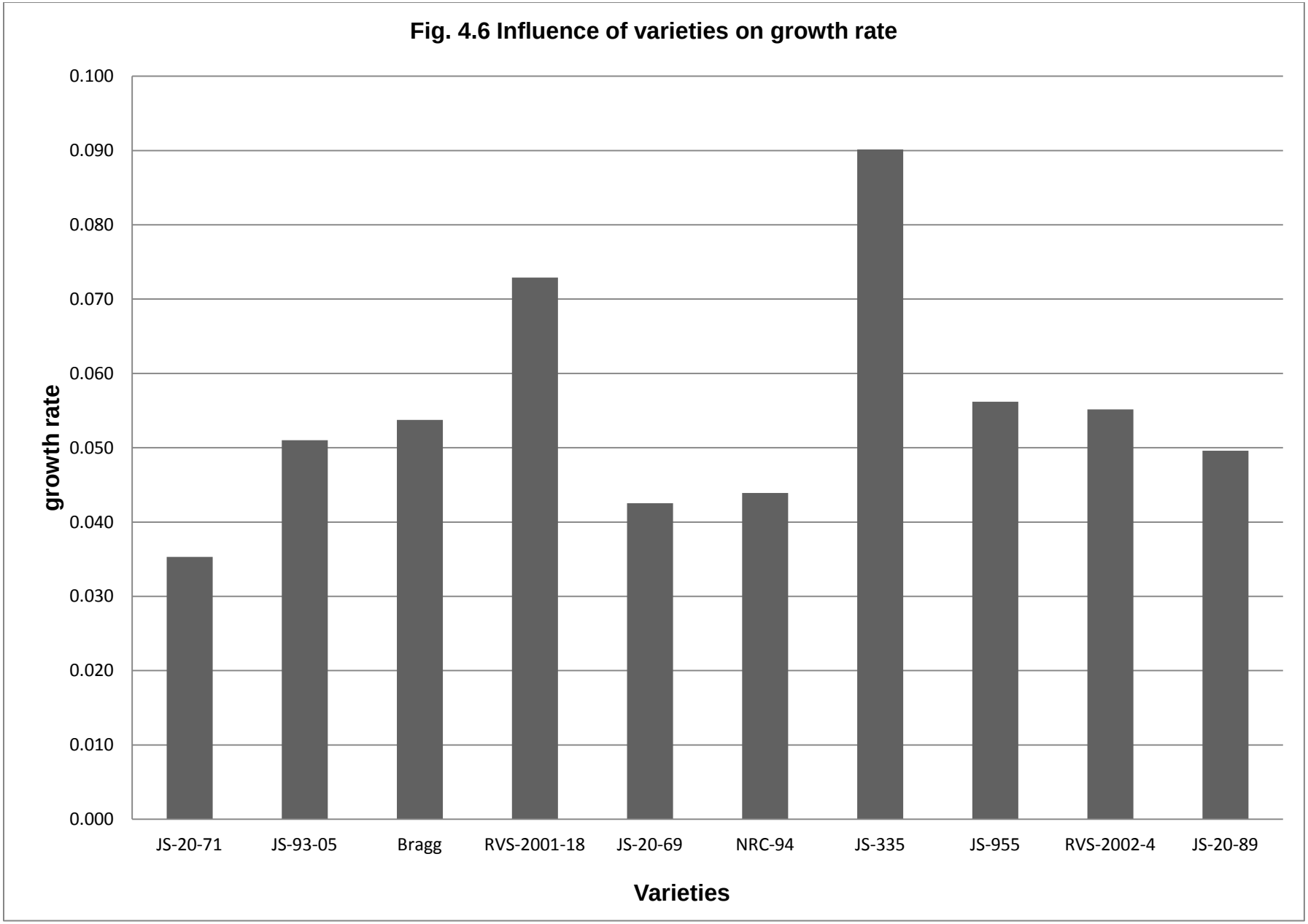


Table 4.7: Influence of varieties on efficiency of conversion of ingested food (E.C.I.).

S. No.	Varieties	E.C.I. (%)
1.	JS-20-71	08.67
2.	JS-93-05	13.02
3.	Bragg	13.72
4.	RVS-2001-18	18.61
5.	JS-20-69	10.86
6.	NRC-94	11.21
7.	JS-335	23.05
8.	SL-955	14.30
9.	RVS-2002-4	13.18
10.	JS-20-89	15.21
	S.Em (±)	**1.59**
	CD at 5%	**4.71**

(viii) Influence of varieties on approximate digestibility (A.D.)

Data computed on approximate digestibility (A.D.) showed significant influence of varieties against *S. obliua* (Table 4.8). Minimum and significantly less A.D. of the larvae (48.88%) was recorded in variety RVS-2002-4 than rest of the varieties. Whereas maximum A.D. (89.73%) was recorded in variety Bragg which found significantly higher than rest of the varieties, except JS-2071, JS-93-05, RVS-2001-18, JS-20-69, NRC-94 and JS-20-89 .

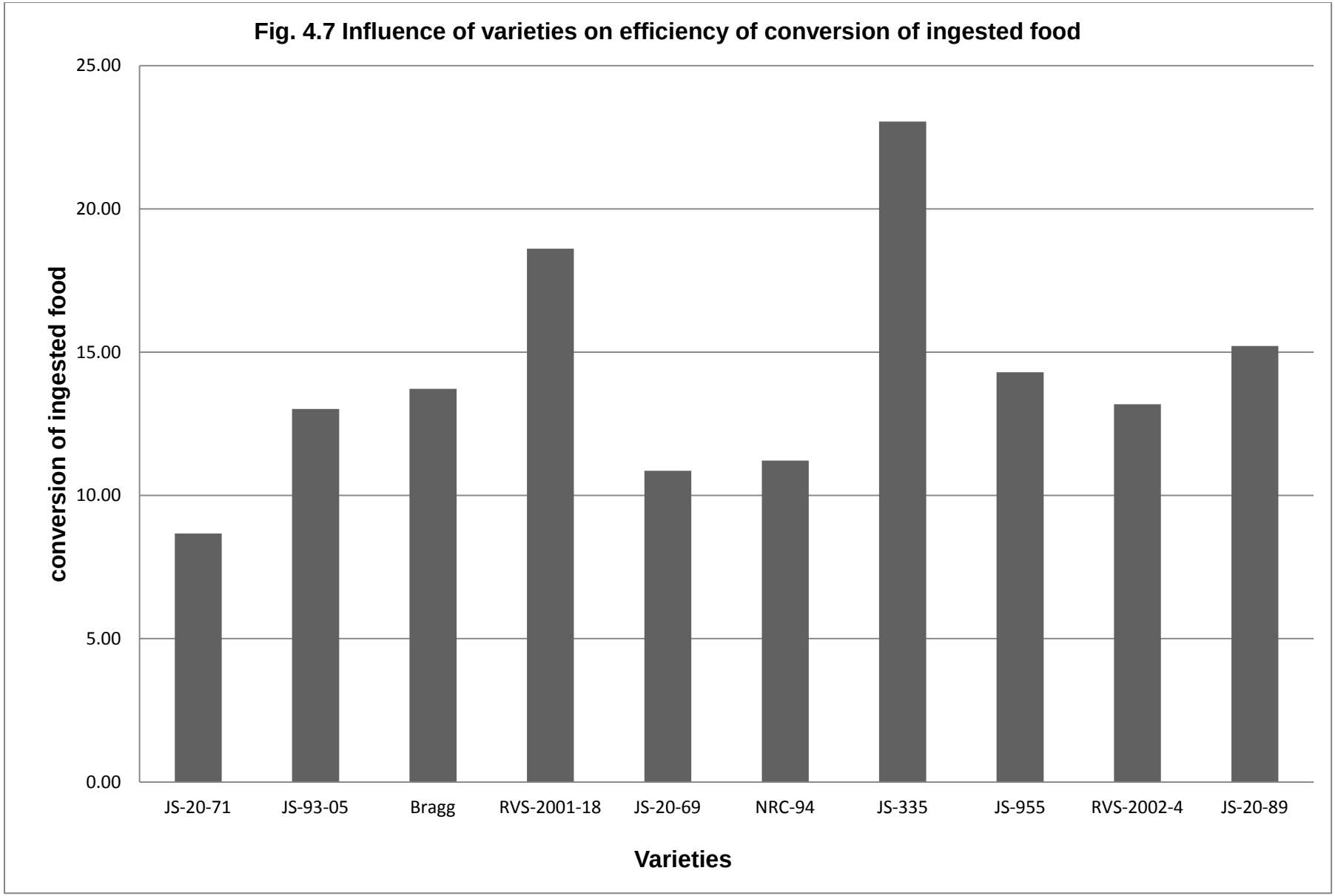


Fig. 4.7 Influence of varieties on efficiency of conversion of ingested food
25.00
20.00
15.00
10.00
5.00
0.00
conversion of ingested food
JS-20-71
JS-93-05
Bragg
RVS-2001-18
JS-20-69
NRC-94
JS-335
JS-955
RVS-2002-4
JS-20-89
Varieties

Table 4.8 : Influence of varieties on Approximate digestibility (A.D.).

S. No.	Varieties	A.D. (%)
1.	JS-20-71	86.70 (68.80)*
2.	JS-93-05	83.91 (66.55)
3.	Bragg	89.73 (71.82)
4.	RVS-2001-18	87.41 (69.32)
5.	JS-20-69	84.92 (67.37)
6.	NRC-94	82.88 (66.25)
7.	JS-335	62.66 (52.53)
8.	SL-955	72.03 (46.68)
9.	RVS-2002-4	48.88 (40.01)
10.	JS-20-89	86.54 (68.77)
	S.Em (±)	**(04.87)**
	CD at 5%	**(14.48)**

* Figures in Parentheses indicate arc sin transformed values.

(B) Efficacy of plant extracts against *S. obliqua*

(I) Effect on consumption of leaves :

Data recorded on weight of leaves consumed by larvae with at different days of release of *S. obliqua* were statistically analyzed and presented in Table 4.12.

Observation recorded at 2 days after release showed that all the extracts reduced the leaves consumption by the larvae over control. consumption of leaves (0.025 g) was recorded in Oak fruit extract significantly less than rest of the plant extract except Margosa leaves extract, Whereas among extracts, maximum and significantly higher leaves consumption (0..052 g) was recorded in Parthenium leaves extract as compare to rest of the extracts.

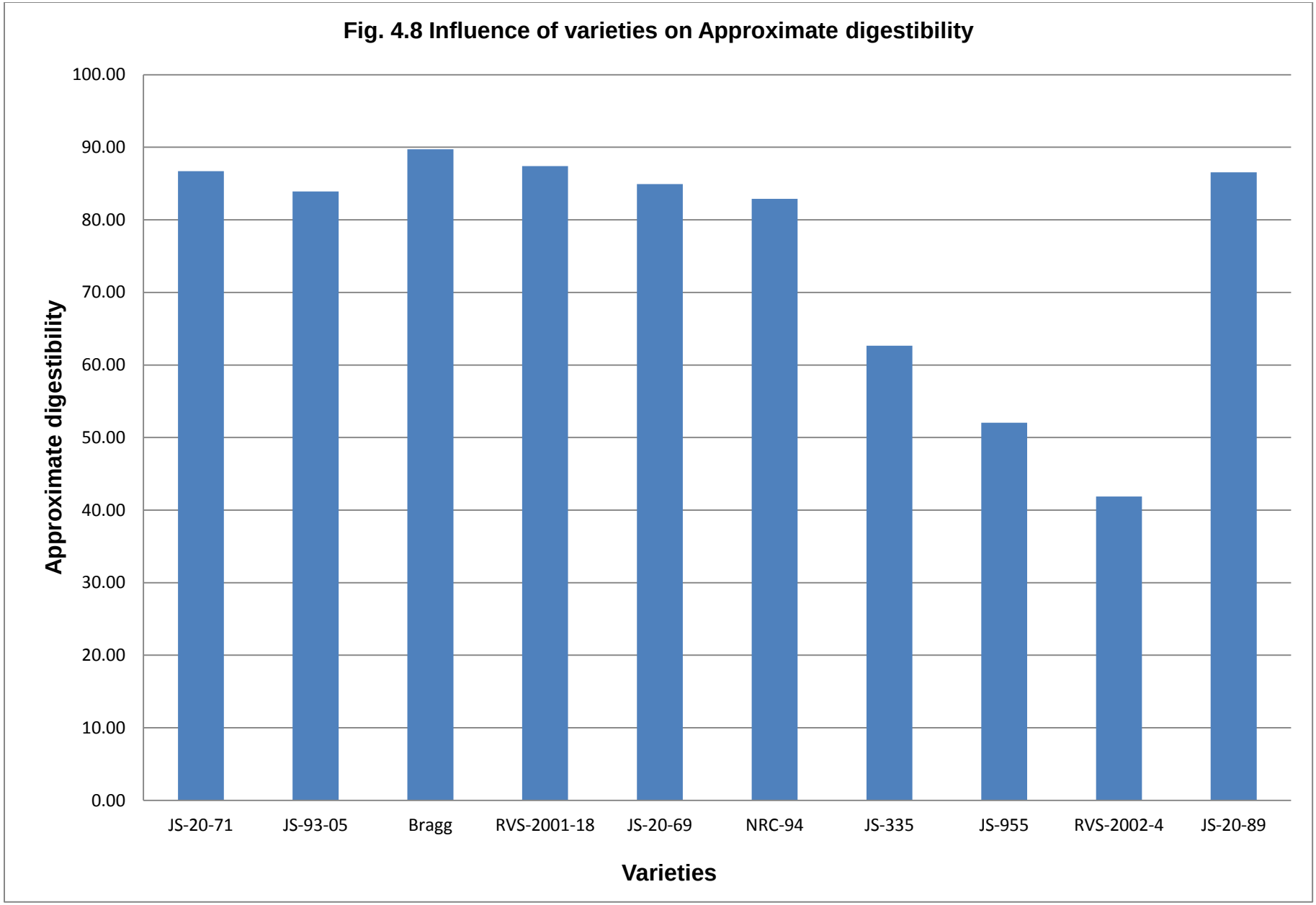


Fig. 4.8 Influence of varieties on Approximate digestibility
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Approximate digestibility
JS-20-71
JS-93-05
Bragg
RVS-2001-18
JS-20-69
NRC-94
JS-335
JS-955
RVS-2002-4
JS-20-89
Varieties

Table 4.9 : Effect of plant extracts on leaves consumed by larvae of *S. obliqua*.

Plant extract	**Leaves consume (g) by larvae days after release.**				
	2	**4**	**6**	**8**	**10**
Margosa leaves	0.026	0.055	0.111	0.158	0.222
Dhatura fruits	0.033	0.090	0.151	0.221	0.295
Parthenium leaves	0.052	0.123	0.212	0.291	0.391
Garlic bulb	0.034	0.109	0.118	0.264	0.309
Tulsi leaves	0.042	0.094	0.153	0.228	0.305
Oak (madar) fruits	0.025	0.056	0.107	0.141	0.213
Green Chilli fruits	0.045	0.087	0.143	0.232	0.275
Control	0.102	0.219	0.287	0.294	0.422
S.E. (m)±	**0.001**	**0.002**	**0.003**	**0.005**	**.006**
C.D. (at 5%)	**0.004**	**0.006**	**0.008**	**0.013**	**.017**

Observation recorded at 4 days after release showed that all the extracts reduced the leaves consumption by the larvae over control. Consumption of leaves (0.055 g) was recorded in Oak fruit extract significantly less than rest of the plant extract except Margosa leaves extract, Whereas among extracts, maximum and significantly higher leaves consumption (0.123 g) was recorded in Parthenium leaves extract as compare to rest of the extracts.

Observation recorded at 6 days after release showed that all the extracts reduced the leaves consumption by the larvae over control. consumption of leaves (0.107 g) was recorded in Oak fruit extract significantly less than rest of the plant extract except Margosa leaves extract, Whereas among extracts, maximum and significantly higher leaves consumption (0.212 g) was recorded in Parthenium leaves extract as compare to rest of the extracts.

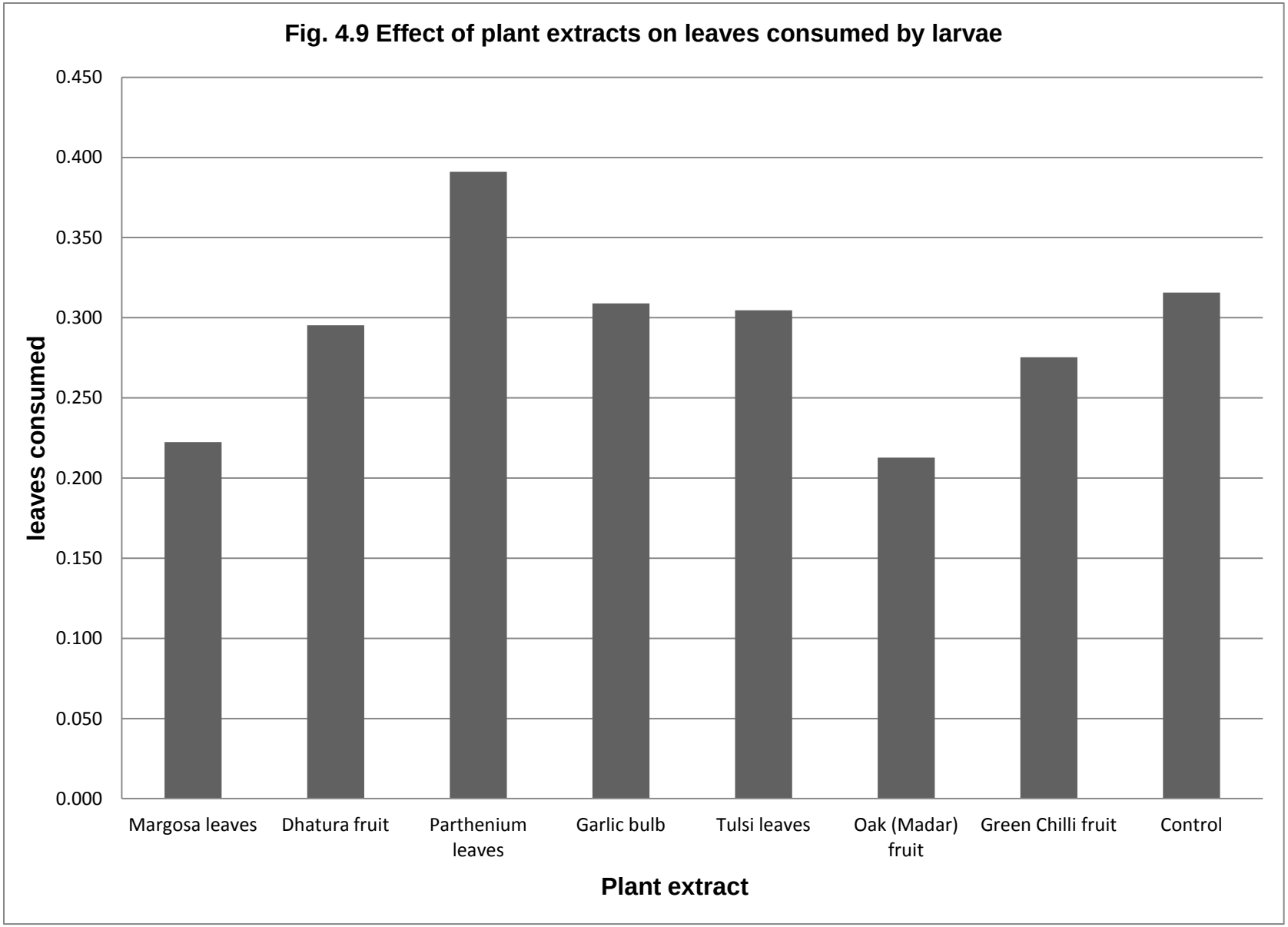


Fig. 4.9 Effect of plant extracts on leaves consumed by larvae
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
leaves consumed
Margosa leaves
Dhatura fruit
Parthenium leaves
Garlic bulb
Tulsi leaves
Oak (Madar) fruit
Green Chilli fruit
Control
Plant extract

Observation recorded at 8 days after release showed that all the extracts reduced the leaves consumption by the larvae over control. Minimum and significantly less consumption of leaves (0.141 g) was recorded in Oak fruit extract and significantly higher as compare to rest plant extract. Among plant extract, maximum leaves consumption (0.291 g) was recorded in parthenium as compare to rest of the extract.

Observation recorded at 10 days after release showed that all the extracts reduced the leaves consumption by the larvae over control. consumption of leaves (0.213 g) was recorded in Oak fruit extract significantly less than rest of the plant extract except Margosa leaves extract, Whereas among extracts, maximum and significantly higher leaves consumption (0.391 g) was recorded in Parthenium leaves extract as compare to rest of the extracts.

(III) Effect of plant extracts on larval mortality

Data recorded at 10 days after release of larvae on the leaves treated with different plant extract showed that only Margosa leaves extract was found significantly effective with regard to larval mortility. The larval mortility in rest of the plant extract treated leaves ranged from 26.67% to 33.33% as against 20.00 in control.

Table 4.10 : Effect of plant extracts on larval mortality of *S. obliqua*.

Plant extract	**Larval mortality (%)**
Margosa leaves	53.33 (46.90)*
Dhatura fruits	26.67 (30.98)
Parthenium leaves	26.67 30.77)
Garlic bulb	33.33 (34.99)
Tulsi leaves	33.33 (35.20)
Green chilli fruits	33.33 (34.99)
Oak (madar)	20.00 (26.06)
Control	26.67(30.77)
S.E.(m)	**(03.57)**
C.D.(at 5%)	**(10.80)**

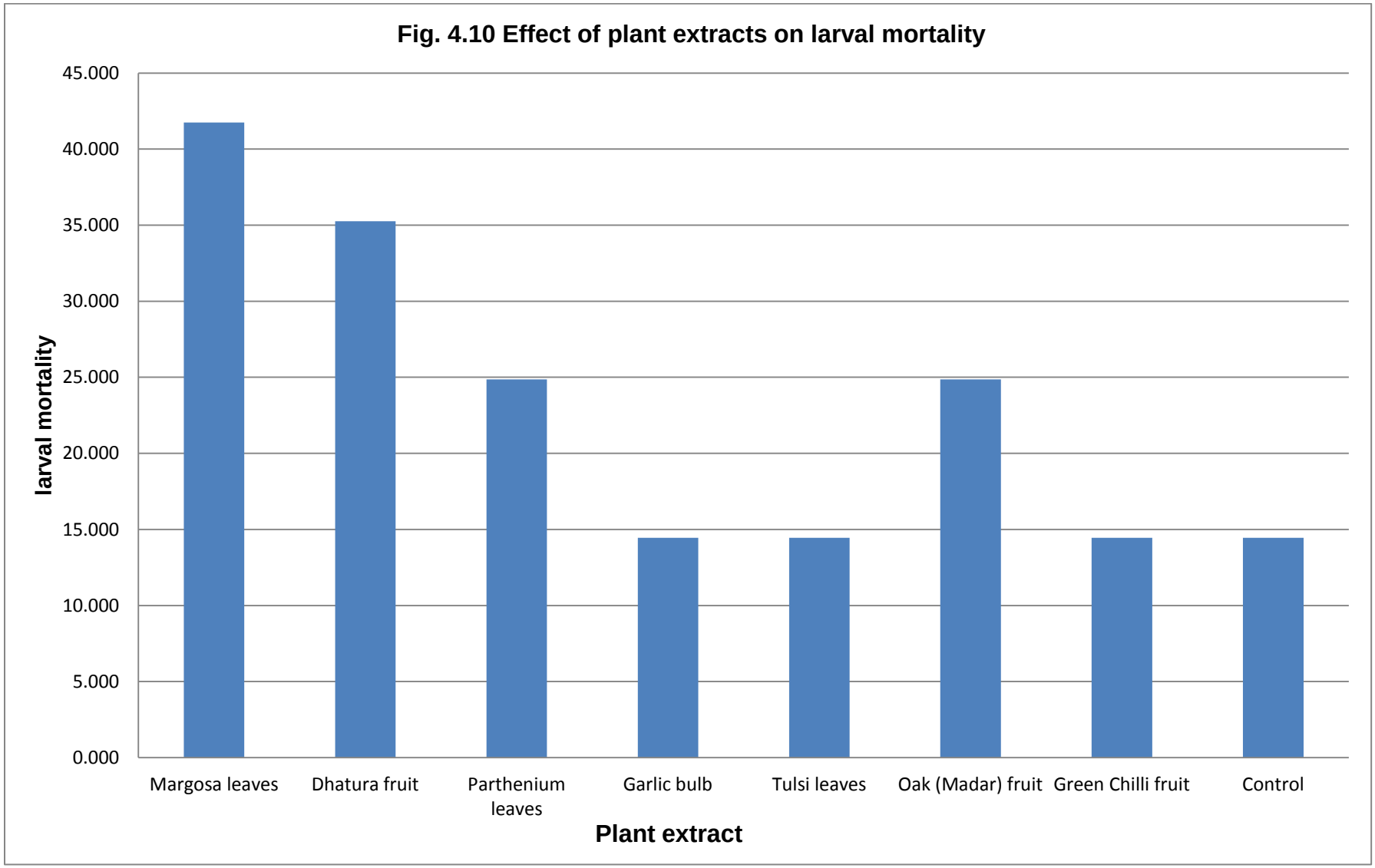


Fig. 4.10 Effect of plant extracts on larval mortality
45.000
40.000
35.000
30.000
25.000
20.000
15.000
10.000
5.000
0.000
larval mortality
Margosa leaves
Dhatura fruit
Parthenium leaves
Garlic bulb
Tulsi leaves
Oak (Madar) fruit
Green Chilli fruit
Control
Plant extract

CHAPTER - V
DISCUSSION

Reaction of ten varieties of soybean was assessed on the basis of leaves consumption by larva, weight gained by larva, larval length, larval period, consumption index (C.I.), Growth rate (G.R.), efficiency of conversion of ingested food (E.C.I.) and approximate digestibility (A.D.) against Bihar hairy caterpillar. The efficacy of seven plant extract was also studied against bihar hairy caterpillar, on the basis of leaves consumption and larval mortality. The result so obtained are discussed here with.

Reaction of soybean varieties against Bihar hairy caterpillar

The consumption of leaves by the larvae of *Spilosoma obliqua* was significantly influenced by different varieties. It ranged from 3.918 g (NRC-94) to 7.243 g (RVS-2001-18). On the basis of leaves consumption, variety NRC-94 was found least preferred for feeding followed by JS-20-71, JS-20-69. Whereas, variety RVS-2001-18 was found most preferred for feeding followed by JS-335. Showed highly susceptibility for feeding to the pest. Singh *et al.* (1999) and Babu *et al.* (1979) also reported non preference mechanism of resistance in soybean varieties against bihar hairy caterpillar. Bhadauria *et al.* (1998) also reported non preference mechanism of resistance in soybean varieties against bihar hairy caterpillar.

The weight of the larvae reared on different varieties was also influenced significantly, it ranged from 0.498 g (JS-20-71) to 1.041 g (RVS-2001-18). The minimum larval weight on variety JS-20-71 indicate. It indicate the presence of antibiosis Mechanism of resistance in the varieties which influence the growth of the larvae. Maximum larval weight recorded in larvae reared on JS-335 also indicate this highly susceptible to Bihar hairy caterpillar. Neupane *et al*. (1991) also reported the antibiosis mechanism of resistance against bihar hairy caterpillar on different varieties of soybean.

The larval length of the larvae reared on different variety was also influenced significantly. It ranged from 29.34 mm in variety NRC-94 to 41.13 mm in variety RVS-2001-18. The minimum length of larvae was recorded on variety NRC-94 followed by variety JS-20-71, Bragg, JS-20-69, RVS-2002-4. which also indicate the influence of

these variety on growth of the larvae significantly, On other hand maximum length of larvae recorded on variety RVS-2001-18 showed this highly susceptible to the pest. Singh *et al*. (1995) also reported significant influence on larval length of bihar hairy caterpillar reared on different genotype of sunflower.

The larval period was also influenced significantly by different varieties of Soybean. It ranged from 17.31 to 20.98 days, respectively. Maximum larval period recorded in variety NRC-94 indicate that the increase in larval period may be due to the presence of antibiosis mechanism of resistance in this variety. Neupane *et al*. (1991) also reported the antibiosis mechanism of resistance against bihar hairy caterpillar on different varieties of soybean.

The data computed on consumption index (C.I.), growth rate (G.R.), efficiency of conversion of ingested food (E.C.I.) and approximate digestibility (A.D.) also showed significant influence of different varieties on consumability, digestibility and growth rate of the pest.

The consumption index (C.I.) on different variety ranged from 0.0387 in variety NRC-94 to 0.0715 in variety RVS-2001-18, Indicated that this variety influenced the consumability of the leaves due to their antifeedency to the pest.

The efficiency of conversion of ingested food (E.C.I.) on different variety ranged from 8.67% in variety JS-20-71 to 23.05% in variety JS-335. The minimum efficiency of conversion of ingested food (E.C.I.) of the larvae recorded in JS-20-71 followed by varieties JS-93-05, JS-20-69, NRC-94 and RVS-2002-4 indicated that this variety influenced the consumability of the leaves due to their antifeedency to the pest.

The approximate digestibility (A.D.) on different varieties ranged 48.88 from in variety RVS-2002-4 to 89.73% in variety Bragg. The minimum approximate digestibility (A.D.) of the larvae recorded in variety RVS-2002-4 indicated that this variety influenced the consumability of the leaves due to their antifeedency to the pest. Shrivastava *et al*. (1999) also reported significant influence on approximate digestibility of Bihar hairy caterpillar reared on different varieties of Soybean.

The growth rate (G.R.) on different varieties ranged from 0.035 in variety JS-20-71 to 0.090 in variety JS-335. The minimum growth rate (G.R.) of the larvae recorded in JS-20-71 followed by varieties JS-93-05, Bragg, JS-20-69, NRC-94, SL-955 and RVS-2002-4 indicated that this variety influenced the consumability of the leaves due to their antifeedency to the pest.

Efficacy of plant extract against Bihar hairy caterpillar

Observation recorded on weight of leaves consumed by larvae under different treatments showed that all the plant extract, reduced the consumption of leaves significantly over control. The consumption of leaves among different plant extract ranged from 0.213 g in Oak (madar) Fruit extract to 0.391 g in parthenium as against 0.422 g in control treatment. Maximum reduction in consumption of leaves recorded in Partenium leaves extract, reduction in consumption of leaves due to their antifeedant and toxic effect causing mortality of the pest. On the basis of minimum leaves consumption Margosa leaves was most effective. Oak fruit was found least effective against the pest. Singh *et al.* (2005) and Mandal *et al.* (2003) was also reported the antifeedant effect of margosa leaves against bihar hairy caterpillar.

The mortality of larvae reared on different plant extract ranged from 26.67% to 53.33% as against 20.00% in control. Larval mortality on the leaves treated with Margosa leaves was significantly higher on all the plant extract. Babu *et al.* (1996), Snowal and Bhattacharya (2008) and Massey and Mishra (2005) was also recorded neem leaves extract to be most effective against Bihar hairy caterpillar.

CHAPTER - VI

SUMMARY, CONCLUSION & SUGGESION FOR FUTHER WORK

Studies on reaction of ten varieties of soybean and efficacy of seven plant extracts prepared in Water against bihar hairy caterpillar, *Spilosoma obliqua* (Walk.) were conducted in laboratory of Department of Entomology, College of Agriculture, Gwalior during 2014-15. The parameters taken for the studies were consumability of the leaves, weight of larvae, larval period, larval length, consumption index (C.I.) growth rate (G.R.) efficiency of conversion of ingested food (E.C.I.) and approximate digestibility (A.D.). The obtained data are summarized here with.

The consumption of leaves by the larvae of *Spilosoma oblique* was significantly influenced by different varieties. It ranged from 3.918 g (NRC-94) to 7.243 g (RVS-2001-18). On the basis of leaves consumption, variety NRC-94 was found least preferred for feeding followed by JS-20-71, JS-20-69. Whereas, variety RVS-2001-18 was found most preferred for feeding followed by JS-335.

The weight of the larvae reared on different varieties was also influenced significantly, it ranged from 0.498 g (JS-20-71) to 1.041 g (RVS-2001-18). The minimum larval weight on variety JS-20-71 indicate presence of the growth inhibiting factor against the pest. The maximum larval weight was recorded on variety (RVS-2001-18) indicate that this variety was highly susceptible to the pest.

Larval period of the larvae reared on different varieties was also influenced significantly by different varieties. It ranged from 17.31 days (RVS-2001-18) to 20.98 days (NRC-94). Maximum larval period on variety NRC-94 indicate the adverse effect of variety on growth and development of larvae. Minimum larval period on variety (RVS-2001-18) indicate that this variety was highly susceptible to the pest.

Larval length of the larvae reared on different varieties was also influenced significantly by different variety. It ranged from 29.34 mm (NRC-94) to 41.13 mm (RVS-2001-18). Minimum larval length was recorded on variety NRC-94 indicates the adverse effect of variety on growth and development of larvae.

Data computed on consumption index (C.I.) showed significant influence of the variety on consumability by the pest. It ranged from 0.0387 (NRC-94) to 0.0715

(RVS-2001-18). Variety NRC-94 was least preferred for consumption followed by JS-93-05, Bragg, JS-20-69, SL-955, RVS-2002-4 and JS-20-89.

Data computed on growth rate (G.R.) was also proved significant influence of the varieties on growth and development of the pest. It ranged from 0.035 (JS-20-71) to 0.090 (JS-335). On the basis of G.R. the variety JS-20-71 found least suitable for the development of Bihar hairy caterpillar followed by JS-93-05, Bragg, JS-20-69, NRC-94, SL-955 and RVS-2002-4.

Data computed on efficiency of conversation of ingested food (E.C.I.) was also proved significant influence of the varieties on growth and development of the pest. It ranged from 8.67 (JS-20-71) to 23.05 (JS-335). On the basis of efficiency of conversation of ingested food (E.C.I.) the variety JS-20-71 found least suitable for the development of Bihar hairy caterpillar followed by varieties JS-93-05, JS-20-69, NRC-94 and RVS-2002-4.

Data computed on approximate digestibility (A.D.) was also proved significant influence of the varieties on growth and development of the pest. It ranged from 62.66% (JS-335) to 89.73 (Bragg). On the basis of approximate digestibility (A.D.) the variety Bragg found least suitable for the development of Bihar hairy caterpillar followed by JS-2071, JS-93-05, RVS-2001-18, JS-20-69, NRC-94 and JS-20-89.

Observation recorded on weight of leaves consumed by larvae under different treatment showed that all the plant extract reduced the consumption of leaves significantly. The consumption of leaves among different plant extract ranged from 0.213 g in Oak fruit to 0.391 g in Parthenium leaves as against 0.422 g in control treatment. Maximum reduction in consumption of leaves was recorded in Oak fruit extract.

Observation recorded on mortality of larvae under different plant extract showed that only Margosa leaves extract reduced the population significantly. However the mortality among different plant extract ranged from 26.67% in Oak fruit and Partenium leaves extract to 53.33% in Margosa leaves.

Conclusion

1. On the basis of weight of leaves consumed by the larvae and consumption index (C.I.), the variety NRC-94 was found least preferred for feeding followed by JS-20-71 and JS-20-69.
2. Variety NRC-94 showed nonpreference mechanism for feeding against the bihar hairy caterpillar.
3. On the basis of weight gained by larvae, larval length, growth rate (G.R.) E.C.I., A.D., larval period, the variety JS-20-71 showed, growth retardant effect against bihar hairy caterpillar.
4. Variety JS-20-71 showed antibiosis mechanism of resistance against the pest.
5. Variety JS-20-71 was found less susceptible followed by NRC-94. Whereas, variety RVS-2001-18 and JS-335 were found more susceptible to the pest.
6. Plant extract of Oak (Madar) fruit was found effective in reducing the consumability of the leaves followed by Margosa leaves extract.
7. On the basis of larval mortality margosa leaves extract was found effective against Bihar hairy caterpillar.

Suggestions for further works

1. All the tested varieties may be screened under field and Net house conditions to obtained resistant donner against bihar hairy caterpillar.
2. Effective plant extracts may be tested under field conditions in different concentrations to find out their efficacy for management of the pest.

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VITA

The author of this thesis, **Kanhaiyalal Thanna**, S/o Shri K.S. Thanna, was born on 4th April, 1989 at Village - Ladusa, Distt.-Mandsaur (M.P.).

He passed high school examination in first division (71 %) from Govt. higher seecondry school Digonmali, Mandsaur (M.P.) in 2006. After that he completed in higher secondary examination with first division (61 %) in 2008 from Govt. boys H.S. School No.-02 Mandsaur (M.P.).

He joined B.Sc. (Ag.) degree programme in College of Agriculture, Gwalior in the year 2009 and completed his degree programme during the year 2013 with an OGPA 7.03 out of 10 scale.

After completing graduation he was selected for M.Sc. (Ag.) degree programme in Entomology and was admitted in College of Agriculture, Gwalior (M.P.). He has completed all required courses in M.Sc. (Ag.) by obtaining approximately 73.0 per cent marks.

The author may be contacted at:

Kanhaiyalal Thanna

Village+Post- Ladusa

Teh.+Distt.- Mandsaur (M.P.)