Ann. Bangladesh Agric. (2015) 19 : 71-78 *ISSN 1025-482X*

EVALUATION OF SOME PLANT MATERIALS AGAINST POD BORER INFESTATION IN COUNTRY BEAN WITH REFERENCE TO FLOWER PRODUCTION

M T Ahmed[1], M R U Miah[1], M R Amin[1] and M M Hossain[2]

Abstract

The study evaluated the efficacy of the aqueous extracts of black pepper, chili, turmeric, coriander, neem, basil and garlic plants, and oils of neem, eucalyptus and mahogany seeds against the infestation of pod borer, *Maruca vitrata* attacking country bean. The plant extracts and oil treatments were used with doses of 20 g/l and 5ml /l water, respectively. In control treatment tap water was sprayed. The application of the treatments was started from the advent of infestation and repeated 6 times at 7 day interval. The mahogany and neem oils, and chili extract provided statistically lower level of pod infestation of country bean compared to other treatments. All the plant materials exerted statistically higher and significant infestation reduction over control, and did not affect flower production of the crop. Overall findings indicated that the neem oil, mahogany oil and black pepper powder may be considered as an effective option for the management of pod borer infesting country bean field in respect to flowering.

Keywords: *Lablab purpureus, Maruca vitrata*, plant extracts, oils

Short title: Evaluation of plant materials against pod borer attacking country bean

Introduction

Country bean, *Lablab purpureus* L. is known as "seem" in Bangladesh; is an important vegetable and an income generating crop. This bean is also grown for fodder and as a cover crop. Country bean leaves and seeds contain 20 - 28% protein with well-balanced amino acids (Schaaffhausen 1998). Country bean also contains tyrosinase enzyme, which has potential use in the treatment of hypertension. In addition, bean pods provide vitamin A, vitamin C, riboflavin, thiamine and different minerals like magnesium, calcium, phosphorus, potassium, iron, sulfur and sodium (Gopalan *et al*. 1982).

Due to high price and increasing demand, farmers of Bangladesh are cultivating country bean in a large scale (Alam *et al.* 2005). But different insect species attack this crop and cause severe damage. On the contrary, the increasing temperature and CO_2 gases cause irremediable rainfall and drought, which enhances pest problems and reduces the effectiveness of current pest management strategies (Amin *et al.* 2013).

Pod borer, *Maruca vitrata* Fabricius (Lepidoptera: Pyralidae) is a major pest of country bean in Bangladesh. Its larvae damage stems, peduncles, flowers and pods of the crop. To protect bean crops from the infestation of pod borer, farmers generally

[1]Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh.
[2]Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh.

use chemical insecticides inadvertent manner. The injudicious and careless application of synthetic insecticides results in polluting environment, dissemination of pollinator and predator species. The chemicals are hazardous to farm workers and consumers, and in pest resistance and resurgence (Nas 2004, Azad *et al.* 2010, Hossain *et al.* 2013).

Now-a-days there is growing interest in the application of botanical pesticides for crop protection (Pedigo 2002). This eco-friendly management tactics has a great chance to save the beneficial insects as well as microorganisms living in soil and plant. On the contrary, botanical products are safe to apply, unique in action and can easily be processed. Most of the botanical products are also cost effective and readily available to the farmers in time.

For successful production of country bean avoiding hazardous effect of chemical pesticides, botanical products may be considered as an effective tool in IPM program. Therefore, in this study, black pepper, chili, turmeric, coriander, neem leaf, basil leaf and garlic leaf extracts and oils of neem, eucalyptus and mahogany seeds were applied in the country bean field with a view to evaluating their effectiveness on *M. vitrata* infestation, and investigating their effect on flower production of the crop.

Materials and Methods

Study Site and Climatic Conditions: The study was carried out in the research field of the Department of Entomology Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur, Bangladesh (25°25′ North latitude and 89°5′ East longitude) during February to August 2013. The study area is dominated by sal, *Shorea robusta* Gaertn forest. The annual mean maximum and minimum temperatures, relative humidity and rainfall in this area are 36.0 and 12.7 ^{o}C, 65.8% and 237.6 cm, respectively.

Cultivation of the crop

The seeds of country bean (variety IPSA Seem-2) were collected from the Department of Horticulture, BSMRAU and cultivated in a randomized complete block design with a plot size of 3.0 × 2.0 m replicated 3 times. The spacing between blocks was 0.5 m and between plots was 1.0 m. Seeds were sown on 2nd February 2013 in rows. Each plot contains only one row with 5 pits, 60 cm apart. After emergence of seedlings, the plants were supported by bamboo sticks to facilitate creeping. The manures and fertilizers were applied according to recommended doses. Intercultural operations such as mulching, weeding, irrigation etc were done whenever necessary. The crops were exposed to sucking insect attack especially aphid was managed by two times with foliar spray of synthetic pyrethroid, Ripcord 10 EC @ 1 ml/l of water.

Collection and Preparation of Plant Extracts and Oils

In this study, black pepper, chili, turmeric and coriander plant products, leaves of neem, basil and garlic, and oils of mahogany, neem and eucalyptus seeds were tested along with an untreated control (water) treatment. Dried black pepper, chili, turmeric and coriander were bought from Gazipur market, and the

neem, basil and garlic leaves were collected from BSMRAU campus. The collected plant materials were washed with tap water and dried for 7 days in sunlight. Then, the materials were dried in an oven at 60°C for 24 h to obtain constant weight. The plant materials were powdered by using an electric blender and passed through 18 mesh screen and stored at 28°C in tightly closed dark glass bottles. The powders (20 g) of each plant materials were separately macerated in 2.5 l reagent bottles using 1 l of distilled water, and then the samples were shaken for 72 h using an electric shaker. Ten drops of 2% sodium dioctyl sulfo-succinate was added to each reagent bottle. The extracts were decanted through a muslin cloth and the decanted materials were preserved as 20 g/l concentration of plant extracts. Pure mahogany, neem and eucalyptus oils were collected from Shatkhira and 5 ml of each was dissolved in one liter water to obtain 5 ml/l concentration.

Monitoring of Pests and Application of Treatments

The experimental field was monitored daily to observe the infestation of pod borer. The plant materials were sprayed with a knapsack sprayer at 7 days interval from the advent of infestation and repeated 6 times. The damaged and undamaged pods were harvested ten times of which first three were considered as early fruiting stage, next four as mid fruiting stage and last three as late fruiting stage.

Data Collection

Data were recorded on (i) number of flower production per inflorescence (ii) percent pod infestation by number at early, mid and late fruiting stages, (iii) percent pod infestation by weight at early, mid and late fruiting stages, and (iv) percent infestation reduction of the treatments over control was calculated. To know the effect of plant materials on flower production, every week one inflorescence from each plot was randomly selected and number of flower per inflorescence were counted. This procedure was started after one week of the first spray and repeated six times following 7 days interval. During harvesting of the crops damaged and undamaged pods were counted separately and their weight was measured.

Statistical Analysis

Data of the flower production per inflorescence, percent pod infestation by number and weight were analyzed by one way analysis of variance (ANOVA) and the mean values were separated by Duncan multiple range test (DMRT). Chi statistic (χ^2) was employed to analyze the percent infestation reduction of the treatments over control. All the analyses were performed using SPSS (IBM Statistics 21.0).

Results and Discussion

The effect of plant materials on the flower production of country bean are presented in Figure 1. The number of flower per inflorescence among the treatments varied from 21.0 ± 2.1 to 22.3 ± 3.0 and the results did not differ significantly. Hossain (2009) observed 18.0 to 20.3 flower/ inflorescence in country bean (IPSA Seem-2). Plant materials possess slow realizing biodegradable compounds which are toxic to herbivore insects but show lower toxicity on host pants. In our study, the tested plant materials had no phytotoxicity

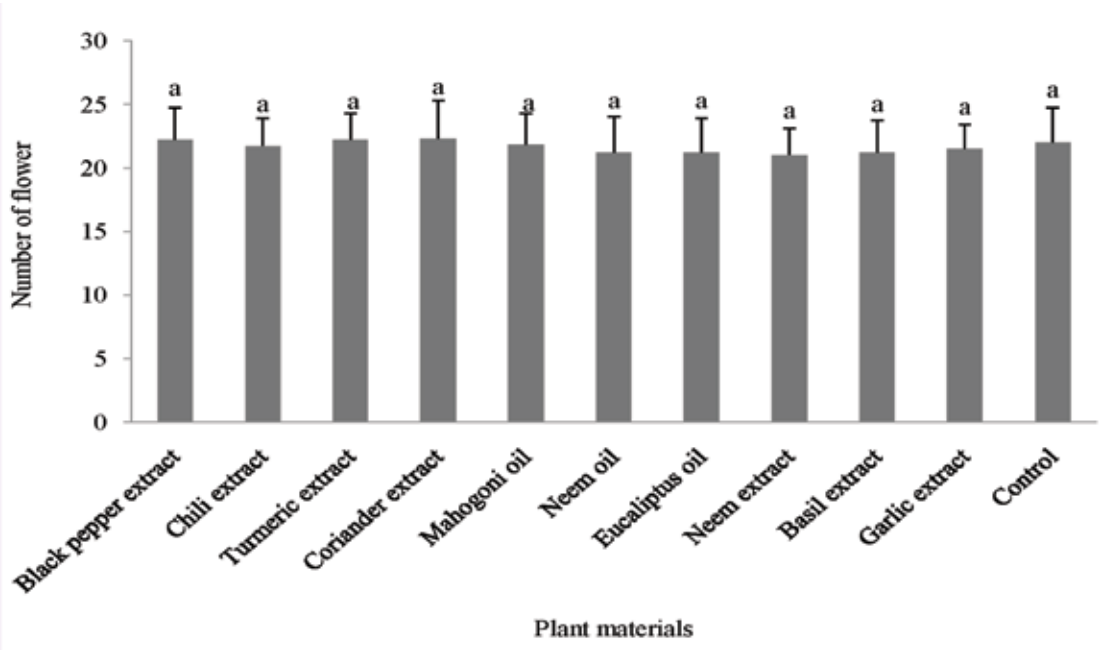

Fig. 1. Effect of different plant materials on the flower production (mean ± SD / inflorescence) of country bean.

symptom on country bean plants, thus flower production was uninterrupted.

Percent of pod infestation (by weight) at early, mid and late fruiting stages are presented in Table 1. Results showed that the pod infestation ranged from 12.7 ± 0.4 to 24.6 ± 0.2% and there was significant difference among the treatments. All the treatments revealed significantly lower percentage of infestation than control. Among the treatments, chili powder (12.7 ± 0.4%) and mahogany oil (13.0 ± 0.6%) exerted statistically identical as well as lower percentage of infestation. In the mid fruiting stage, the pod infestation (by weight) varied from 12.8 ± 0.1 to 25.9 ± 0.3% and the results revealed significant difference. The plant materials caused significantly lower rate of infestation than control. The neem oil (11.2 ± 0.3%), chili powder (12.8 ± 0.1%) and mahogany oil (13.6 ± 0.1%) showed statistically similar as well as lower rate of infestation. There was found significant difference among the treatments in the percent of pod infestation at late fruiting stage. Pod infestation ranged from 11.9 ± 0.1 to 24.3 ± 0.1%, and the results demonstrated that the plant materials exerted significantly lower rate of pod infestation compared to control. Among the treatments, chili powder (11.9 ± 0.1%), mahogany oil (11.9 ± 0.1%) and neem oil (11.9 ± 0.1%) showed statistically similar as well as lower rate of infestation. Alam *et al.* (2005) found that crashed neem seed kernal reduced infestation level of pod borer in bean field.

Table 2 indicated the percentage of pod infestation (by weight) reduction over control at early, mid and late fruiting stages. The infestation reduction at early fruiting stage ranged from 22.4 to 48.4% and the

Table 1. Effect of different plant materials on the percent of pod infestation (by weight) of country bean by pod borer at early, mid and late fruiting stage.

Treatment	% of pod infestation at different fruiting stage		
	Early fruiting	Mid fruiting	Late fruiting
Black pepper extract	18.0 ± 0.3 c	15.8 ± 0.2 e	17.8 ± 0.2 c
Chili extract	12.7 ± 0.4 f	12.8 ± 0.1 g	11.9 ± 0.1 f
Turmeric extract	18.2 ± 0.6 c	17.1 ± 0.2 d	18.8 ± 0.2 b
Coriander extract	19.1 ± 0.4 b	17.9 ± 0.2 c	18.9 ± 0.1 b
Mahogany oil	13.0 ± 0.6 f	13.6 ± 0.1 f	11.9 ± 0.1 f
Neem oil	13.7 ± 0.3 e	11.2 ± 0.3 h	11.9 ± 0.1 f
Eucalyptus oil	15.1 ± 0.2 d	17.1 ± 0.1 d	18.9 ± 0.1 b
Neem leaf extract	17.9 ± 0.2 c	17.2 ± 0.1 d	17.9 ± 0.2 c
Basil leaf extract	18.0 ± 0.2 c	20.2 ± 0.1 b	16.9 ± 0.1 d
Garlic extract	18.0 ± 0.2 c	20.0 ± 0.1 b	16.1 ± 0.1 e
Control (Untreated)	24.6 ± 0.2 a	25.9 ± 0.3 a	24.3 ± 0.1 a

Data expressed as mean ± SD. Means within a column followed by same letter(s) are not significantly different (DMRT, $_{p}\leq 0.05$)

Table 2. Effect of different plant materials on the percent of pod infestation (by weight) reduction of country bean over control by pod borer at early, mid and late fruiting stage.

Treatment	%Amount of pod infestation reduction over control		
	Early fruiting	Mid fruiting	Late fruiting
Black pepper extract	26.8	39.0	26.8
Chili extract	48.3	50.6	51.0
Turmeric extract	26.0	34.0	22.6
Coriander extract	22.4	31.0	22.2
Mahogany oil	47.2	47.5	51.0
Neem oil	44.3	56.8	51.0
Eucalyptus oil	38.6	34.0	22.2
Neem leaf extract	27.2	33.6	26.3
Basil leaf extract	26.8	22.0	30.5
Garlic extract	26.8	22.8	33.7

results showed significant difference. The highest and lowest reduction over control were recorded in the mahogany oil and garlic extract, respectively. In the mid fruiting stage, pod infestation reduction (by weight) over control ranged from 22.0 to 56.8% and the results differed significantly. Among the plant materials chili and basil leaf extracts revealed the highest and lowest reductions, respectively. Percent pod infestation reduction (by weight) over control at late fruiting stage ranged from 22.2 to 51.0% and the results differed significantly. The highest percent of reduction was recorded in the mahogany oil and the lowest result was found in basil leaf extract. Mollah *et al.* (2009) reported that neem oil exerted 56.5% pod infestation reduction over control in country bean by pod borer.

Percent of pod infestation (by number) at early, mid and late stages are presented in Table 3. The infestation ranged from 13.8 ± 0.3 to 25.8 ±0.4% and the results depicted significant difference. The plant materials showed significantly lower infestation (by number) than control. Among the treatments, mahogany oil resulted in the lowest level of pod infestation (13.8 ± 0.3%). In the mid fruiting stages, pod infestation varied from

Table 3. Effect of different plant materials on the percent of pod infestation (by number) of country bean by pod borer at early, mid and late fruiting stage.

Treatment	% of pod (by number) infestation at different fruiting stage		
	Early fruiting	Mid fruiting	Late fruiting
Black pepper extract	18.3 ± 0.4 cd	17.4 ± 0.1 e	18.4 ± 0.1 e
Chili extract	15.0 ± 0.4 g	12.8 ± 0.2 g	13.4 ± 0.1 g
Turmeric extract	18.8 ± 0.4 c	19.3 ± 0.4 cd	18.9 ± 0.1 d
Coriander extract	17.3 ± 0.2 e	19.7 ± 0.4 bd	19.3 ± 0.2 bc
Mahogany oil	13.8 ± 0.3h	13.3 ± 0.1 fg	12.7 ± 0.2 h
Neem oil	15.9 ± 0.4 f	14.6 ± 0.3 f	13.0 ± 0.1 gh
Eucalyptus oil	17.8 ± 0.4de	18.9 ± 0.2 de	19.1 ± 0.1 cd
Neem leaf extract	18.9 ± 0.4 c	20.8 ± 0.2 bc	18.2 ± 0.2 e
Basil leaf extract	18.0 ± 0.7 d	21.1 ± 0.1 b	19.6 ± 0.3 b
Garlic extract	20.6 ± 0.3 b	18.2 ± 0.1 de	16.5 ± 0.5 f
Control	25.8 ±0.4 a	28.6 ± 0.5 a	26.6 ± 0.3 a

Data expressed as mean ± SD. Means within a column followed by same letter(s) are not significantly different (DMRT, $_{p}\leq 0.05$)

12.8 ± 0.2 to 28.6 ± 0.5% and the results exerted significant difference. The plant materials showed significantly lower percentage of pod infestation (by number) than control and chili powder was found to be the most effective. There was significant difference among the treatments in percent of pod infestation (by number) at late fruiting stage. The rates ranged from 12.7 ± 0.2 to 26.6 ± 0.3% and the treatments showed significantly lower rate of infestation compared to control. The mahogany oil showed significantly the highest performance in reducing pod infestation. Sarkar (2005) reported that neem oil at the concentration of 10 ml/l water reduced 50.7% infestation of *Helicoverpa armigera* in chickpea.

Table 4 indicated the percentage of pod infestation (by number) reduction over control at early, mid and late fruiting stages. The infestation reduction at early fruiting stage ranged from 20.2 to 46.5% and the results showed significant difference. The highest and lowest reductions over control were recorded in the mahogany oil and garlic extract, respectively. In the mid fruiting stage, infestation reduction over control ranged from 26.2 to 55.2% and the results differed significantly. The chili and basil leaf extracts resulted the highest and lowest reductions, respectively. Percent pod infestation reduction over control at late fruiting stage ranged from 26.3 to 52.3% and the results differed significantly. The highest percent reduction over control was recorded in the mahogany oil and the lowest was found in basil leaf extract. The effectiveness of the treatments indicated that mahogany oil, neem oil and chili extract performed better in reducing pod infestation at early, mid and late fruiting stages. Hossain *et al.* (2003) reported that neem oil provided 42.9% reduction over control in bitter gourd from the infestation of epilachna beetle.

The aqueous extracts of black pepper, neem, garlic and onion reduced the egg viability and hatching of *M. vitrata* and *Clavigralla tomentosicollis* in laboratory condition (Ekesi 2000). Romesh and Pandey (2005) found that 5% neem seed kernel extract killed early stages larvae of *M. vitrata* in the bean field. Jyothi *et al.* (2003) observed that 2 and 4% neem oil emulsion significantly affected the egg hatching of *Cheilomenes sexmaculatus*.

Plant materials possess different kinds of alkaloid and terpinoid compounds such as

Table 4. Effect of different plant materials on the percent number of pod infestation (by number) reduction of country bean over by pod borer at early, mid and late fruiting stage.

Treatment	%Number of pod infestation reduction over control		
	Early fruiting	Mid fruiting	Late fruiting
Black pepper extract	29.1	39.2	30.8
Chili extract	41.9	55.2	49.5
Turmeric extract	27.1	32.5	29.0
Coriander extract	33.0	31.1	27.4
Mahogany oil	46.5	53.5	52.3
Neem oil	38.3	48.5	51.1
Eucalyptus oil	31.0	33.9	28.2
Neem leaf extract	26.7	27.3	31.6
Basil leaf extract	30.2	26.2	26.3
Garlic extract	20.2	36.4	38.0

azadirachtin, azdirol, cymarin, digitoxin, kulactone, limocinin, salanin, toosendanin and xanthotoxin (Roy *et al.* 2014). These compounds are toxic to insects and interrupt their feeding, mating, oviposition, growth and development. Plant materials also show repellent, antifeedant and mortality effect on insects and thus reduce infestation rates (Amin *et al.* 2009). In this study all the plant materials provided significantly lower percentage of infestation compared to control, and the results indicated that the tested plant materials may be effective for protection of country bean from the attack of *M. vitrata*.

References

Alam, M.Z., F.M.A. Rouf, A.K. Rahman and A. Cork. 2005. Determination of the status of different borer pest complex of country bean. *Ann. Rept., Bangladesh Agril. Res. Inst.*, Gazipur, Bangladesh. Pp. 32-37.

Amin, M.R., D.A. Tithi, H.M.S. Azad, S.M.A. Hossain and H.R. Mian. 2009. Evaluation of some botanicals and a chemical insecticide against few chewing and sucking pests of cotton at different locations of Bangladesh. *J. Environ. Sci. Nat. Resources.* **2:** 9-12.

Amin, M.R., H.M.S. Azad, S.M.A. Hossain, D.A. Tithi. 2013. Pest, predator and pollinator abundance in the cotton field of Bangladesh: A climate change country. In: Sundaresan, J., S. Sreekesh, A.L. Ramanathan, L. Sonnenschein and R. Boojh (eds). Climate change and environment. Scientific Publishers, India. Pp.100-106.

Azad, H.M.S., M.R. Amin, S.M.A. Hossain and D.A. Tithi. 2010. Field abundance and incidence of predator associated with different cotton varieties at Dinajpur in Bangladesh. *J. Environ. Sci. Nat. Resources.* **3**: 127-130.

Ekesi, S. 2000. Effect of volatiles and crude extracts of different plant materials on egg viability of *Maruca vitrata* and *Clavigralla tomentosicollis*. *Phytoparasitica.* **28:** 305-310.

Gopalan, C.V., B.Y. Ramasastri and S.C. Balasnbramarun. 1982. Nutritive values of Indian food. *Natl. Inst. Nutrition, ICMR,* Hyderabad, India. p. 75.

Hossain, M.S. 2009. Integrated non-chemical management of major insect pests of year round country bean. A Ph. D. Dissertation submitted to the Dept.

Entomol., Bangabandhu Sheikh Mujibur Rahman Agril. Univ., Gazipur, Bangladesh. P. 723.

Hossain, M.S., K. Pbaidullah, S. Akhter, M. Begum and M.M. Rahman. 2003. Integrated management of epilachna beetle of bitter gourd. *Bangladesh J. Agril. Sci.* **30:** 247-252.

Hossain, S.M.A., M.A. Baque, M.R. Amin. 2013. Comparative effectiveness of seed treating and foliar insecticides against sucking pests of cotton and impact on their natural enemies. *Bangladesh J. Agril. Res.* **38**: 61-70.

Jyothi, M., V.T. Sannaveerappanavar, P.L. Tandon, C.R. Ballal, S.K. Jalali and R.J. Rabindra. 2003. Contact toxicity of aqueous neem seed kernel extract and neem seed oil to different life stages of *Cheilomenes sexmaculata* (Fabdricius) (Coleoptera: Coccinellidae). *Proc. Symp. Biol. Conf. Lepidoptera Pests,* Bengalore, India. Pp. 47-48.

Mollah, M.M.I., M.M. Rahman, M.Z. Alam and M.M. Hossain. 2009. Yield performance of heat tolerant country bean (*Lablab purpureus* L.) as influenced by insecticides during kharif season. *J. Entomol. Zool. Studies.* **1:** 3-5.

Nas, M.N. 2004. In vitro studies on some natural beverages as botanical pesticides against *Erwinia amylovora* and *Curobacterium flaccumfaciensis*. *Turk. J. Agric*. **14:** 45-48.

Pedigo, L.P. 2002. Entomology and pest management. Prentice Hall, New Jersey, USA. p. 83.

Romesh and Pandey. 2005. Efficacy of botanical pesticides against *Maruka vitrata* in field bean. *Food Chem. Toxicol*. **41:** 413-417.

Roy B., M.R. Amin, S. Jalal, Y.J. Kwon and S.J. Suh. 2014. Evaluation of common cocklebur *Xanthium strumarium* leaf extract as post-harvest grain protectant of black gram against pulse beetle *Callosobruchus chinensis* (Coleoptera: Bruchidae) and isolation of crude compound. *Ent. Res.* **44:** 254-261.

Sarker, A. 2005. Management of chickpea pod borer, *Helicoverpa armigera* Hubner using conventional and non-conventional techniques. *Ann. Rept., Bangladesh Agril. Res. Inst,* Gazipur, Bangladesh. Pp. 4-9.

Schaaffausen, R.V. 1998. *Dolichos lablab* or Hyacinth bean- its use for feed, food and soil improvements. *Econ. Bot.* **17:** 146-153.

Guidelines to Author
(Ann. Bangladesh Agric.)

Annals of Bangladesh Agriculture is published biannually in June and December by Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU). Annals of Bangladesh Agriculture publishes original unpublished articles on all disciplines of research and education in agriculture including rural development. However, emphasis is given on the aspects of crop science in Bangladesh. In addition to original articles, review articles are considered for publication.

Manuscript Submission: Double-spaced manuscripts should be written in English, printed on one side of A4-size paper with 2.5 cm margins all around using the font Times New Roman, 12 point. Text of a full paper should not exceed 12 typed pages excluding photographs, tables and figures. Short communication should not exceed six typed pages. Manuscript submitted for the first time should be in duplicate and sent to Executive Editor, Annals of Bangladesh Agriculture, BSMRAU, Gazipur 1706, Bangladesh. Manuscript is subjected to go through the review process. Manuscripts not complying with the format and style of the Journal or of unacceptable quality will be notified to the author(s). Author(s) of the articles accepted for publication have to submit the original manuscript along with the revised one on a CD together with a hard copy signed by the principal/corresponding author. Articles reporting research findings of five years old or more are not considered for publication in Ann. Bangladesh Agric.

Contents

Page 1: Title of the article and name(s) of the author(s) with address should be typed. **Page 2 :** Title, Abstract and Keywords should be typed. **Page 3 onward:** Introduction, Materials and Methods, Results and Discussion, Acknowledgement (if any) and References should follow in an unbroken sequences.

Short Communication should not have sectional headings except abstract.

Title: Title should represent the text in minimum possible worlds without verbs/auxiliary verbs. It should be indicative rater than narrative.

Abstract: An abstract is not a part of the text, it has single entity, which is self explanatory and comprehensive with minimum words not exceeding 200. It contains purpose of the study, location, gist of the findings with relevant treatments and concluding remarks.

Text: The text of the article should be clear, precise and comprehensive.

Tables and Figures: Same data must not be presented in both table(s) and figure(s).

Table(s) and figure(s) must be numbered and should be referred to as Table 1 or Fig. 1, etc. Each Table should be self explanatory and typed on a separate sheet and be headed by a brief legend. All original figures should be in finished form ready for reproduction. Photographs should be glossy print with strong contrasts. Colour photographs will be printed in colour only at the author's expense. For both tables and figures, the desired point of insertion should be marked in the right margin of the text. Tables and Figures should be printed in A4-size paper.

References

In the text: For single author: Ahmed (2000) or Ahmed, 2000; for two authors: Ahmed and Hamid (2000) or (Ahmed and Hamid, 2000); for more than two authors: Ahmed *et al* (2000) or (Ahmed *et al.,* 2000); for more than one publication of the same author appeared in the same year: Ahmed (2000a, 2000b) or (Ahmed, 2000a & 2000b); for more than one citation at a time: (Karim *et al,*\ 976: Hamid 1 : Ahmed and Hamid, 2000).

In the reference/citation section: References must be included and arranged alphabetically according to surname of first author and it should **be** ii.

Ayub, A., T. K. Dey, M. Jahan and M. Z. Rahman. 1996. Assessment of yield loss due to powdery mildew of blackgram. *Bangladesh J. Plant Pathol.* 12: 9-1*1*

Hill, D.S. 1787. Agricultural Insect Pests of the Tropics and Their Control 2nd ed. Cambridge Univ. Press, New York, USA. 746 P.

Troughton, J.H. 1975. Phytoshynthetic Mechanisms in Higher Plants, Pp. 357-91. In Cooper J.P. (ed.) Photosynthesis and Productivity in Different Environments. Cambridge Univ. Press, Cambridge, UK.

Reprints: Contributors are entitled to get 20 copies of reprints free of cost for each article.