Original Article

Effect Of Different Concentrations of Pre-Emergence Herbicides on Growth, Yield and Pest Incidence in Brinjal (Solanum melongena L.) Cv. Pant Rituraj under Subtropical Condition of Garhwal Hills

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Abstract

Brinjal is an important economic flowering vegetable crop that belongs to the family solanaceae. Fruitful brinjal production in our nation is restricted by several biotic and abiotic factors including weeds. Weeds compete with the main crop for growth resources like nutrients, moisture, sunlight and space affecting the yield of the crop. In addition, it also acts as alternate hosts that harbour insect-pests and diseases ultimately resulting in huge crop loss. Thus, with the objective of finding suitable measures to control weeds for obtaining higher quality yield in brinjal, a field experiment was undertaken at Horticultural Research Centre, Chauras Campus, Department of Horticulture, H.N.B. Garhwal University, Srinagar, Garhwal, Uttarakhand to evaluate the effect of different concentrations of pre-emergence herbicides in brinjal Cv. Pant Rituraj under subtropical condition of Garhwal Hills. The experiment was laid-out in randomized block design with three replications. The treatments of the experiment were comprised of different pre-emergence herbicides with applied at doses along with the hand weeding operation. The result of the experiment revealed that among all the treatments used, treatment T_1 comprising of Alachlor 50% EC @ 1.0 kg a.i ha^{-1} + hand weeding at 45 DAT resulted in better performance in terms of weed index, number of marketable fruits, average fruit weight, yield per plot and cost benefit ratio followed by treatment T_2 Alachlor 50% EC @ 1.5 kg a.i ha^{-1} + hand weeding at 45 DAT. Therefore, pre-emergence herbicide such as Alachlor 50% EC @ 1.0 kg a.i ha^{-1} + hand weeding at 45 DAT can be used to control weeds and to obtain higher quality yield in brinjal under subtropical condition of Garhwal hills.

Key words: Brinjal, Control, Efficiency, Herbicides, Pre-emergence and Weed

INTRODUCTION

Brinjal (*Solanum melongena* L.) is an important economic flowering vegetable crop that belongs to the family solanaceae. It is also known as King of vegetables and holds a great importance in Indian diet. It is grown in different tropical and sub-tropical regions of the world including India. In India, it is grown in an area of 0.72 million hectares with an annual production of 12.68 million tonnes (NHB 2018). In terms of nutritional content fresh brinjal fruit contains 1.4 g protein, 18 mg calcium, 47 mg phosphorus, 0.11 mg riboflavin, 0.9 mg niacin, 124 IU vitamin A and 15 mg vitamin C per 100g (Hazra 2019). Fruits of brinjal are also rich source of dietary fibres, vitamin B_1, B_3, B_6, C, K, pantothenic acid, beta-carotene equivalents and folate along with alkaloids namely tropane, pyrrolidine, quinazolizidine, steroid alkaloids, and glycoalkaloids (Tiwari *et al.*, 2020). Such vegetable crop is reported to be enriched with polyphenol compounds

(Salamatullah *et al.*, 2021) and possesses several antioxidant properties due to the presence of flavonoids (Das and Barua 2013) in its fruit which makes it a well acceptable vegetable for the consumers benefiting human health.

Despite its enormous area under cultivation and several improved agronomic practices, fruitful brinjal production in our country is still restricted by several biotic and abiotic factors, one of which is growth of unwanted plants *i.e.* weeds. Successful brinjal cultivation comes across severe weed competition due to its slow initial growth and wider spacing resulting in competition of crop for growth resources like nutrients, moisture, sunlight and space. In addition, weeds also act as alternate hosts that harbour insect-pests and diseases ultimately resulting in huge crop loss. It has been reported that yield reduction in brinjal due to weeds is up to 58% in un-weeded plots as compared to weed free check plots (Bangi *et al.*, 2014).

Controlling of weeds by the means of hand weeding is considered as an effective measure to control weeds but due to its laborious, time consuming and repeated weeding requirement, it increases the cost of cultivation. Under such conditions, valuable technology with less cost and labour requirement will be helpful for the farmers in controlling weeds effectively and use of pre-emergence herbicide for controlling weed is one of such measures.

The commercialization of some acceptable chemicals in agriculture system with low environmental pollution has offered a wide spectrum of herbicides including pre-emergence herbicides which can accomplish the weed control at much lower cost than mechanical and hand weeding with minimum complications thereby increasing yield. Thus, with respect to the all above mention facts a field experiment was undertaken to study the effect of different concentrations of pre-emergence herbicides on growth, yield and pest incidence in brinjal under subtropical condition of Garhwal hills.

MATERIAL AND METHODS

A field experiment was conducted at Horticultural Research Centre, Chauras Campus, Department of Horticulture, H.N.B. Garhwal University, Srinagar Garhwal, Uttarakhand (India) during summer season 2017 to study the effect of different concentrations of pre-emergence herbicides in brinjal. The experimental field was situated in Alakananda valley which lies between 78°47'30" E longitude and 30°13'0"N latitude at an elevation of 540 m above MSL. The experiment was laid-out in randomized block design with three replications. The experimental material (variety) used in this experiment was Pant Rituraj. The treatments were comprised of of T_1: Alachlor 50% EC @ 1.0 kg a.i ha^{-1} + hand weeding at 45 DAT, T_2 : Alachlor 50% EC @ 1.5 kg a.i ha^{-1} + hand weeding at 45 DAT, T_3 : Pendimethalin 30% EC @ 1.0 kg a.i ha^{-1} + hand weeding at 45 DAT, T_4 : Pendimethalin 30% EC @ 1.5 kg a.i ha^{-1} + hand weeding at 45 DAT, T_5 : Oxadiargyle 80% WP @ 90 g a.i ha^{-1} + hand weeding at 45 DAT, T_6 : Oxyfluorfen 23.5%EC @ 0.15 kg a.i ha^{-1} + hand weeding at 45 DAT, T_7 : Control (no treatment). Spraying of herbicides was done three days after transplanting with the help of hand sprayer using water as carrier @ 750 litre ha^{-1}. The observations were recorded regarding growth parameters such as plant height (cm) at 30, 60 and 90 DAT and number of leaves per plant 30, 60 and 90 DAT, yield parameters such as number of marketable fruits, number of unmarketable fruits, average fruit weight (g) and yield per plot (kg), weed related parameters viz. number of weeds per plot, fresh weight of weeds (g), dry weight of weeds (g), weed control efficiency (%) and weed index (%), pest incidence parameter such as incidence of fruit borer (%) and cost:benefit ratio. For the growth and yield related parameters data were recorded from five randomly selected plants and for weed related parameters weeds were removed from each plot (3.24 m^2) at 90 DAT for recording various observations.

Dry weight of weeds (g): Weeds from each plot were uprooted and the soil around the root portion was removed. The weeds were dried in sunlight until the moisture was completely removed. The dry weights of weeds were taken with help of weighing balance.

Weed control efficiency (%): The weed control efficiency was calculated on the basis of reduction in dry matter production in treatment plot in comparison with the control plot and expressed in percentage. Weed control efficiency was computed at 90 DAT of crop.

$$\text{WCE (\%)} = \frac{\text{DMC} - \text{DMT}}{\text{DMC}} \text{X } 100$$

Where,
WCE = Weed control efficiency
DMC = Dry weight of weeds in unweeded check plot
DMT = Dry weight of weeds in treated plot

Weed index (%): To know the impact of weed control method on crop yield, weed index was calculated by the following formula.

$$\text{WI (\%)} = \frac{\text{X} - \text{Y}}{\text{Y}} \text{X } 100$$

Where,
X = Highest yield obtained
Y = Yield from treated plot

Fruit borer infestation (%): Fruits from each plot were collected. Out of the fruits collected, the numbers of fruits infected by fruits borer were counted. Fruit borer incidence percentage was calculated by following formula:

$$Fruit\ borer\ infestation\ percentage = \frac{\text{Number of fruits infected}}{\text{Total number of fruits}} \text{ X } 100$$

The data on various characters under study were analysed by the method of analysis of variance as described by Snedecor and Cochran (1967).

RESULT AND DISCUSSION

Effect of treatments on weeds: *Merremia emarginata, Dactyloctenium aegyptium, Malvastrum coromandelianum, Amaranthus viridis, Ageratum houstonianum, Ipomea pestigris, Sorghum halepense and Cynodon dactylon* were recorded as the most common weeds in the experimental field. A perusal of data (Table 1) in the present study revealed that, lowest number of weeds (12.27), lowest fresh weight of weeds (380.00g), lowest dry weight of weeds (189.00g) and highest weed control efficiency (69.89%) were recorded in treatment T_5 (Oxadiargyle 80% WP @ 90 g a.i ha-^{1} + hand weeding at 45 DAT). However, the lowest weed index (19.32) was observed in treatment T_1 (Alachlor 50% EC @ 1.0 kg a.i ha-^{1} + hand weeding at 45 DAT). According to Hilli and Santlemann (1969), the lowest dry weight of weeds can be attributed to fewer weeds, quick carbohydrate depletion and lower photosynthesis activity. This is because fewer weeds are present, less chlorophyll is produced as a result of the herbicide's inhibition of protoposphyrinogen IX oxidase enzyme, and also because the herbicide was present for a longer period of time before harvest. This might also be attributable to improved weed control, which would reduce weed populations and restrict weed development. On the other hand, the effectiveness of herbicides and their viability for weed control rose when they were used in conjunction with hand weeding. By lowering the dry weight of the weeds, the efficiency of several herbicides at various concentrations was demonstrated. Herbicides used as a pre-emergence treatment prevented weeds from emerging from the soil, creating a weed-free environment that favoured minimal competition throughout the seedling and tender period of growth.

Efficiency of treatments on fruit borer incidence: It is evident from the data presented in table 1 regarding incidence of fruit borer (%) that, there was lesser incidence of fruit borer in plots which were treated with different concentrations of herbicides. Among various treatments lowest fruit borer incidence (38.80%) was observed in treatment T_4 (Pendimethalin 30% EC @ 1.5 kg a.i ha-^{1} + hand weeding at 45 DAT). However, the highest incidence of fruit borer was observed in T_7 (control plot). There was no significant difference reported between the treatments in terms of fruit borer incidence. This may be because many insect pests may feed on weeds (an alternative host), and the elimination of such weeds may reduce the populations of insect pests.

Table 1. Effect of different concentrations of pre-emergence herbicides on weeds.

Treatments	No. of weeds per plot	Fresh weight of weeds (g)	Dry weight of weeds (g)	Weed control efficiency (%)	Weed index (%)	Incidence of fruit borer (%)
T_1	18.05	874.00	364.33	41.96	19.32	45.96
T_2	12.91	447.76	193.50	69.17	22.26	59.36
T_3	13.79	510.33	217.16	65.40	30.02	41.40
T_4	12.46	424.66	206.83	67.05	38.73	38.80
T_5	12.27	380.00	189.00	69.89	49.10	54.40
T_6	14.95	905.16	291.16	53.62	65.35	44.11
T_7	22.09	1222.00	627.83	0.00	66.27	62.50
SEm±	1.93	195.29	65.90	10.52	11.69	10.37
CD 5%	5.63	570.01	192.33	30.72	34.12	30.26

Effect of treatments on growth, yield attributes and yield in brinjal: The data (Table 2) presented with respect to the effect of different treatments on growth attributes of brinjal under study reflects that the highest plant height at 30 DAT (53.00cm) was recorded in treatment T_3 (Pendimethalin 30% EC @ 1.0 kg a.i ha-1 + hand weeding at 45 DAT). On the other hand, the plant height at 60 and 90 DAT (92.90cm and 123.00cm) was recorded highest in treatment T_4 (Pendimethalin 30% EC @ 1.5 kg a.i ha^{-1} + hand weeding at 45 DAT). Result with respect to number of leaves showed that the maximum number of leaves at 30 DAT (36.86) was reported in treatment T_3 (Pendimethalin 30% EC @ 1.0 kg a.i ha-^{1} + hand weeding at 45 DAT). On the other hand, the maximum number of leaves at 60 DAT (103.46) was found in treatment T_2 (Alachlor 50% EC @ 1.5 kg a.i ha^{-1} + hand weeding at 45 DAT) while, the maximum number of leaves at 90 DAT (105.46) was observed in treatment T_4 (Pendimethalin 30% EC @ 1.5 kg a.i ha-^{1} + hand weeding at 45 DAT). Hence more herbicide used, the less weeds there were to compete for water and nutrients that are necessary for a successful output. This resulted in a decrease in weed population throughout the later phases of plant growth which ultimately

increase in plant height and leaf count. Similar findings were reported by Kunti *et al.* (2012) and Mekki *et al.* (2010) in brinjal**.**

Table 2. Effect of different concentrations of pre-emergence herbicides on growth parameters of brinjal.

Treatments	Plant height (cm)			Number of leaves		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
T_1	33.06	82.66	117.00	25.20	91.00	98.13
T_2	39.26	85.66	113.60	32.06	103.46	95.53
T_3	53.00	89.33	115.46	36.86	98.26	98.53
T_4	50.26	92.90	123.00	31.60	102.40	105.46
T_5	45.66	83.04	115.80	33.86	102.86	96.60
T_6	26.26	76.00	108.00	19.66	102.33	93.20
T_7	47.53	84.46	116.00	23.80	96.86	101.00
SEm±	3.24	3.84	3.66	4.58	3.25	2.77
CD 5%	9.47	11.22	10.68	13.36	9.48	8.09

The data presented in Table 3 on yield attributes and yield in brinjal under study proves that the maximum number of marketable fruits (7.16), highest average weight of fruit (138.22g), yield per plot (3.11kg) and cost benefit ratio was observed in treatment T_1 (Alachlor 50% EC @ 1.0 kg a.i ha^{-1} + hand weeding at 45 DAT) while, the maximum number of unmarketable fruits (11.14) was found in treatment T_4 (Pendimethalin 30% EC @ 1.5 kg a.i ha-1 + hand weeding at 45 DAT). This might be due to the reduced crop-weed competition increasing the availability of growth factors and also due the lesser incidence of fruit borer. The combined effect of these factors resulted in increasing the yield ultimately increasing cost benefit ratio. Similar results were obtained by Nemade *et al.* (2012) in chilli and Channappagoudar *et al.* (2013) in brinjal.

Table 3: Effect of different concentrations of pre-emergence herbicides on yield attributes and yield in brinjal

Treatments	No. of marketable fruits	No. of unmarketable fruits	Average weight of fruit (g)	Yield per plot (kg)	Cost : benefit ratio
T_1	7.16	8.61	138.22	3.11	2.68
T_2	6.98	5.56	130.52	2.99	2.56
T_3	6.91	10.67	111.10	2.79	2.41
T_4	6.2	11.14	128.14	2.40	2.06
T_5	5.66	4.73	101.01	1.98	1.71
T_6	4.68	6.34	106.55	1.31	1.12
T_7	4.75	6.02	108.12	1.24	1.22
SEm±	0.61	1.45	15.76	0.46	0.00
CD 5%	1.17	4.24	46.01	1.34	0.00

CONCLUSION

On the basis of obtained results from the present investigation, it may be concluded that application of pre-emergence herbicide *i.e.* Alachlor 50% EC @ 1.0 kg a.i ha^{-1} followed by hand weeding at 45 DAT resulted the maximum number of fruits per plants, highest average fruit weight, highest yield per plot, lowest weed index and highest benefit cost ratio. Thus, it can be concluded that, pre-emergence herbicide such as Alachlor 50% EC @ 1.0 kg a.i ha^{-1} + hand weeding at 45 DAT can be used to control weeds and to obtain higher quality yield in brinjal under subtropical condition of Garhwal hills.

FUTURE SCOPE

In agriculture, weeds have always played a significant role in yield reduction. One of the main concerns of farmers is weed control while growing crops. The current research focuses on weed control in brinjal crop production. These research findings can therefore be applied further to provide qualitative and quantitative yield, ultimately favouring the farmers' maximum returns.

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CONFLICT OF INTEREST:

None

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