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INFLUENCE OF HERBICIDES ON MORPHO-PHYSIOLOGICAL GROWTH PARAMETERS IN BRINJAL (*SOLANUM MELONGENA* L.)

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ABSTRACT
A field experiment was conducted during summer season of 2009 to study the physiological aspects on weed control efficiency (WCE) in brinjal (*Solanum melongena* L.) at University of Agricultural Sciences, Dharwad. The experiment was laid out in randomized block design with ten treatments consisted of four herbicide treatments at two different concentrations with weed free check and unweeded control and replicated at three times. The morpho-physiological characters and total dry matter accumulation were found to be lowest in unweeded control and application of pendimethalin @ 1.5kg e.*i.* ha^{-1} increased all these parameters. The growth parameters *viz.,* leaf area, LAI, AGR, CGR, NAR, LAD, SLW and BMD were significantly lower in unweeded control while the application of herbicides increased these parameters.

INTRODUCTION

Brinjal (*Solanum melongena* L.) is an important commercial vegetable crop. It belongs to the family solanaceae. Brinjal is also variously known as Eggplant or Aubergine (French name) or Guineasfaush. It is one of the most common, popular and principal vegetable crops grown in India and other parts of world. Weeds pose most serious problem in brinjal cultivation because of liberal use of farmyard manure, chemical fertilizers and frequent irrigations that help the weeds to grow vigorously.

The predominant weed flora that rock the growth and yield of the crop vary with soil type, moisture condition and other climatic factors. Thus, it is necessary to concentrate more on weeding out the undesirable than any other activity related to increasing agricultural production.

Jaiswal (1994) noticed that, weed control efficiency of different herbicides treatmentranged from 40 to 91 per cent and highest WCE was recorded in metribuzin (91%) treatment. Leaf area duration is one of the growth components which has been shown to have direct effect on yield and dry matter production and observed that LAD is correlated with dry matter production and consequently, any practice that increase the longevity of green leaves should increase the dry weight of plants (Power et al., 1967). Leaf area ratio (LAR) is a morphological index of plant (leaf area per unit dry weight of the plant) which is closely connected with the photosynthetic activity of the leaves (Evans, 1972). However, the information on the role of herbicides on weed control efficiency in brinjal and morpho-physiological and biophysical parameters is meager. With this background, the present investigation was carried out to know influence of different herbicides on morpho-physiological traits in brinjal.

MATERIALS AND METHOD

A field experiment was conducted during summer season of 2009 to study the weed control efficiency (WCE) in brinjal (*Solanum melongena* L.) under irrigated condition at College of Agriculture, University of Agricultural Sciences, Dharwad. The experiment was laid out in randomized block design with ten treatments consisted of four herbicide treatments at two different concentrations with weed free check and unweeded control and replicated at three times. The pre-emergence application was made by spraying the herbicides on the soil surface uniformly one day after transplanting of brinjal seedlings with minimum trampling. High volume sprayer was used for the application of herbicides. Immediately after collecting the observations on weed parameters, at 30 days after transplanting one intercultural operation was carried out in all the treatments except in unweeded control. The weed free check was hand weeded as and when weeds were emerged. Dry weight of weeds was recorded at periodical intervals *i.e.*, 30, 60, 90, 120 DAT in each treatment. The weeds were uprooted from the 0.25 m^2 area selected at random each time and were oven dried to a constant weight at 65ºC and the oven dry weight of weeds was recorded. Weed control efficiency (WCE) denotes the magnitude of weed reduction due to weed control treatment. It was worked out by using the formula suggested by Mani *et al*. (1973) and expressed in percentage. The total dry matter and leaf area were recorded at 30, 60, 90 and 120 DAT.

The growth indices like Leaf Area Index (LAI) were calculated

by using the formula suggested by Sestak *et al.*, 1971., Leaf area duration (LAD) and Leaf area ratio (LAR, dm2/g) by Power *et al*. (1967)., Net assimilation rate (NAR, mg dm2/day) were calculated by using the formulae given by Gregory (1926), Absolute growth rate (AGR, g /plant/day) was calculated by using the following formula given by Radford (1967), Relative growth rate (RGR, mg/ g/plant) was calculated by using the formula of Blackman (1919) and Crop growth rate (CGR, g/ m2) was estimated, using formula given by Watson (1956).

RESULTS AND DISCUSSION

Efficiency of different herbicides studied in the experiment in controlling the weeds in brinjal found effective in decreasing the weed dry weight and increases the weed control efficiency. Weed dry matter is a better parameter to measure the competition than the weed number (Murthy, 1982, Bhanumurthy and Subramaniam, 1989). In the present study, unweeded control recorded significantly higher weed dry matter at all the stages of crop growth period due to unchecked growth of weeds (Table 1). The lower weed dry weight of weeds in weed free check was due to complete removal of weeds as whenever they emerged. The lower weed dry weight in weed control treatments may be ascribed to the less number of weeds, rapid depletion of carbohydrate reserves of weeds through rapid respiration (Dakshinadas, 1962) and may be due to reduced photosynthetic activity (Hilli and Santkemann, 1969).

Among various herbicide applied, pendimethalin @ 1.5kg *a.i.* ha^{-1} recorded lowest weed dry matter followed by alachlor @ 1.5kg a.i. ha^{-1} and pendimethalin @ 1.0 kg a.i. ha^{-1} at all the stages of crop growth, while pretilachlor @ 1.0 kg a.i. ha^{-1} was found less effective followed by butachlor @ 1.0 kg a.i. ha^{-1} which is attributed to the differential efficacy of herbicides in suppressing the weed growth. Similar results were also obtained by Gautam *et al*. (1985) and Patel *et al*. (1995) in potato.

Significantly higher weed control efficiency (%) was noticed in weed free check because of season long weed free condition in that treatment. Among the various herbicides, the highest weed control efficiency was obtained in case of pendimethalin @ 1.5kg a.i. ha^{-1} followed by pendimethalin @ 1.0kg a.i. ha^{-1} and alachlor @ 1.5kg a.i. ha^{-1} (Table 1). While, weed control efficiency (%) was lowest in unweeded control. Whereas, weed control efficiency (%) was less in case of pretilachlor @ 1.0kg a.i. ha^{-1} and butachlor @ 1.0kg a.i. ha^{-1} due to phytotoxicity and resulted in lesser weed control efficiency (%) values. Similar results have been obtained by Nadagouda (1995) and Nekar (1997).

The total dry matter accumulation increased from 30 to 120 DAT. The weed free check registered significantly higher total dry matter during 30, 60, 90 and 120 DAT (Table 2) and total dry matter was found to be lowest in unweeded control. This indicates that the weed competition affects various morphological traits and finally reduces the total dry matter production. Among the different herbicides studied pendimethalin @ 1.5 and 1.0kg a.i. ha^{-1} and alachlor @ 1.5kg a.i. ha^{-1} were found to be very much effective in suppressing the weed flora and finally resulted in higher dry matter production in brinjal. Similarly Channappagowda *et al*. (2007) found the effective control of weeds in potato

Leaf area and leaf area index (LAI) increased continuously from 30 to 90 DAT and decrease marginally thereafter in all the treatments (Table 2). The highest LAI was recorded in weed free check, while the lowest was observed in unweeded control treatment. Among the herbicides, the application of pendimethalin @ 1.5kg a.i. ha^{-1} resulted in higher values for leaf area and leaf area index (LAI) at all the stages. However, the application of pretilachlor @ 1.0 kg a.i. ha^{-1} and butachlor @ 1.0 kg a.i. ha^{-1} were phytotoxic and less effective in controlling the weeds and resulted in lower values for leaf area and leaf area index. The present investigation indicated that pendimethalin @ 1.5 kg a.i. ha^{-1} controlled the weeds at all the stages followed by pendimethalin @ 1.0 kg a.i. ha^{-1} and alachlor @ 1.5 kg a.i. ha^{-1} and thus helped the brinjal crop to grow better with higher leaf expansion and thus finally resulting in higher values for leaf area index (LAI). The reduction in the LAI in rice due to weed competition was also observed by the Noda *et al*. (1968).

The leaf area duration (LAD) is the total amount of leaf area present over particular period of crop growth (Table 3). Leaf area duration (LAD) is an important growth parameter that influences competition. Leaf area duration values (LAD) were highest in weed free check, followed by the application of

Table 1: Effect of herbicides and crop weed competition on dry weight of weeds (g 0.25 m^{-2}) and weed control efficiency different stages at different stages in brinjal

Sl. No	Treatments	Dry weight of weeds (g 0.25 m^{-2}) 30 DAT	60 DAT	90 DAT	120 DAT	Weed control efficiency 30 DAT	60 DAT	90 DAT	120 DAT
1	Alachlor @ 1.0 kg a.i. ha^{-1}	0.064 (3.019)	0.725 (4.314)	0.834 (5.830)	0.954 (7.800)	70.87	68.55	64.41	57.55
2	Alachlor @ 1.5 kg a.i. ha^{-1}	0.517 (2.292	0.650 (3.464)	0.769 (4.873)	0.843 (5.960)	77.89	74.75	70.26	68.38
3	Butachlor @ 1.0 kg a.i. ha^{-1}	0.688 (3.875	0.843 (5.963)	0.934 (7.583)	1.015 (9.348)	62.61	56.53	53.65	50.39
4	Butachlor @ 1.5 kg a.i. ha^{-1}	0.656 (3.527	0.784 (5.087)	0.892 (6.805)	0.960 (8.117)	65.97	62.91	58.47	56.93
5	Pendimethalin @ 1.0 kg a.i. ha^{-1}	0.509 (2.230	0.644 (3.405)	0.783 (5.076)	0.873 (6.463)	78.49	75.18	69.02	64.71
6	Pendimethalin @ 1.5 kg a.i. ha^{-1}	0.450 (1.818	0.591 (2.898)	0.717 (4.214)	0.805 (5.382)	82.47	78.87	74.28	71.44
7	Pretilachlor @ 1.0 kg a.i. ha^{-1}	0.692 (3.920	0.841 (5.941)	0.946 (7.836)	1.021 (9.505)	62.18	56.69	52.17	49.57
8	Pretilachlor @ 1.5 kg a.i. ha^{-1}	0.655 (3.521	0.804 (5.376)	0.893 (6.817)	0.976 (8.456)	66.03	60.81	58.38	55.13
9	Weed free check	0.000 (0.00	0.000 (0.00)	0.000 (0.00)	0.000 (0.00)	100.00	100.00	100.00	100.00
10	Unweeded control	1.056 (10.366	1.168 (13.717)	1.240 (16.383)	1.298 (18.847)	0.00	0.00	0.00	0.00
	S.Em +	0.005	0.006	0.007	0.006	0.53	0.55	0.69	0.64
	CD at 5%	0.016	0.018	0.021	0.019	1.57	1.62	2.05	1.89

Figures in parenthesis indicate actual values, DAT – Days after transplanting

Table 2: Effect of herbicides and crop weed competition on total dry weight (g plant^{-1}), leaf area and leaf area index (LAI) at different stages in brinjal

Sl. No.	Treatments	Total dry weight (g plant^{-1})				leaf area (LA dm^2 plant^{-1})				leaf area index (LAI)			
		30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT
1	Alachlor @ 1.0 kg a.i. ha^{-1}	13.23	56.03	166.98	206.23	5.85	24.04	56.99	50.63	0.1300	0.5343	1.2664	1.1250
2	Alachlor @ 1.5 kg a.i. ha^{-1}	13.78	57.73	171.37	211.28	5.92	24.71	57.89	50.93	0.1316	0.5491	1.2864	1.1318
3	Butachlor @ 1.0 kg a.i. ha^{-1}	11.21	47.71	146.12	182.57	5.15	20.63	54.27	47.25	0.1145	0.4584	1.2061	1.0501
4	Butachlor @ 1.5 kg a.i. ha^{-1}	11.57	49.05	149.42	186.42	5.16	21.15	54.29	47.77	0.1147	0.4699	1.2064	1.0615
5	Pendimethalin @ 1.0 kg a.i. ha^{-1}	13.86	57.84	171.20	210.95	5.96	24.64	57.92	50.48	0.1324	0.5475	1.2871	1.1218
6	Pendimethalin @ 1.5 kg a.i. ha^{-1}	14.23	59.21	174.13	214.10	6.07	25.17	58.06	50.94	0.1348	0.5593	1.2901	1.1319
7	Pretilachlor @ 1.0 kg a.i. ha^{-1}	11.06	47.10	144.30	180.16	4.98	20.37	53.53	47.24	0.1106	0.4527	1.1895	1.0499
8	Pretilachlor @ 1.5 kg a.i. ha^{-1}	11.32	48.02	146.50	182.82	5.02	20.70	53.88	47.50	0.1116	0.4600	1.1974	1.0556
9	Weed free check	15.25	63.32	183.92	224.90	6.49	26.04	60.12	51.49	0.1443	0.5787	1.3360	1.1443
10	Unweeded control	9.70	41.50	130.56	164.15	4.47	18.34	49.94	44.76	0.0993	0.4076	1.1097	0.9947
	S.Em +	0.10	0.28	0.57	0.54	0.04	0.13	0.24	0.16	0.0009	0.0028	0.0053	0.0035
	CD at 5%	0.30	0.84	1.69	1.51	0.12	0.37	0.71	0.47	0.0027	0.0083	0.0157	0.0104

DAT – Days after transplanting

pendimethalin @ 1.5kg a.i. ha^{-1}. While, the lowest LAR value was noticed in the treatment unweeded control Dobozi and Lehoczky (2002) also noticed the similar results. Among the herbicide treatments, the application of pretilachlor @ 1.0 kg a.i. ha-1 recorded lower values for leaf area duration (LAD).

Biomass duration (BMD) indicates that the maintenance of dry matter over the period of time and is essential for prolonged supply of photosynthates to the developing sinks. The weed free check recorded significantly higher biomass duration (BMD) values at both stages and it was found to be lowest with unweeded control (Table 3). This suggest that influence of crop weed competition and herbicide treatments results in decreased total dry matter (TDM), leaf area index (LAI), leaf area duration (LAD), leaf area, crop growth rate (CGR), net assimilation rate (NAR), specific leaf weight (SLW) and finally resulted in decreased biomass duration (BMD) (3 AND 4). Among the herbicide treatments studied, higher biomass duration (BMD) values were found with pendimethalin @ 1.5kg a.i. ha^{-1} and thus indicating the superiority of this herbicide in brinjal crop. Singh and Lallan (1987) also observed a close association between biomass (total biological or total dry matter) and tuber yield in potato.

The absolute growth rate (AGR) refers to dry weight increase per unit time. AGR increased from 30-60 DAT to 60-90 DAT and decreased thereafter from 60-90 DAT to 90-120 DAT. The treatment weed free check recorded higher absolute growth rate (AGR) values, while lower absolute growth rate (AGR) values were found with unweeded control. This clearly indicates that the efficiency of the plant in terms of dry matter production is hindered due to crop weed competition and influence of herbicide treatments. Among the herbicide treatments, application of pendimethalin @ 1.5kg a.i. ha^{-1} was found to be more effective and resulted in significantly higher values for absolute growth rate (AGR) as compared to all other herbicide treatments.

Crop growth rate (CGR) is influenced by leaf area index (LAI), photosynthetic rate and leaf angle towards the sunlight. Net assimilation rate (NAR) values were decreased as growth advances from 30-60 DAT to 90-120 DAT and that was mainly due to shading effect and senescence. The specific leaf weight (SLW) is an index of leaf thickness and it increased from 30 to 90 DAT and thereafter SLW decreased slowly from 90 to 120 DAT. The higher values for crop growth rate (CGR), net assimilation rate (NAR) and specific leaf weight (SLW) were found in weed free check. However, the lowest values for CGR, NAR and SLW were noticed in unweeded control. Among the herbicide treatments, application of pendimethalin @ 1.5kg a.i. ha-1 was very effective and registered in significantly higher values for CGR, NAR and SLW and similar results was also observed by Channappagowdar *et al.* (2007. The data clearly indicates that the growth parameters are very much influenced by crop weed competition and herbicide treatments resulted in improving these growth parameters to a greater extent.

REFERENCES

Bhanumurthy, V. B. and Subramanaian, N. S. 1989, Adaptation of new parameters, grain yield competition for weed control study. *Indian J. Agric. Sci.* **59:** 800-801.

Blackman, B. E. and Roberts, H. A. 1950. Studies on selected weed control II, The control of weeds in spring cereals. J. *Agric. Sci.* **40:** 70-

Table 3: Effect of herbicides and crop weed competition on leaf area duration (LAD days), biomass duration (g day-1) and absolute growth rate (AGR g plant-1 day-1) at different stages in turmeric

Sl. No.	Treatments	LAD days			Biomass duration (g day^{-1})			AGR g plant^{-1} day^{-1}		
		30 DAT	60 DAT	90-120 DAT	30 DAT	60 DAT	90-120 DAT	30 DAT	60 DAT	90-120 DAT
1	Alachlor @ 1.0 kg a.i. ha^{-1}	9.96	27.01	35.87	1039	3345	5598	1.427	3.698	1.308
2	Alachlor @ 1.5 kg a.i. ha^{-1}	10.21	27.53	36.27	1073	3437	5740	1.465	3.788	1.331
3	Butachlor @ 1.0 kg a.i. ha^{-1}	8.59	24.97	33.85	884	2908	4930	1.217	3.280	1.215
4	Butachlor @ 1.5 kg a.i. ha^{-1}	8.77	25.14	34.01	909	2977	5037	1.250	3.345	1.233
5	Pendimethalin @ 1.0 kg a.i. ha^{-1}	10.20	27.52	36.13	1075	3436	5732	1.466	3.779	1.325
6	Pendimethalin @ 1.5 kg a.i. ha^{-1}	10.41	27.74	36.33	1102	3500	5823	1.499	3.831	1.332
7	Pretilachlor @ 1.0 kg a.i. ha^{-1}	8.45	24.63	33.59	873	2871	4867	1.201	3.240	1.195
8	Pretilachlor @ 1.5 kg a.i. ha^{-1}	8.57	24.86	33.80	890	2918	4940	1.223	3.283	1.211
9	Weed free check	10.84	28.72	37.20	1179	3709	6132	1.602	4.020	1.366
10	Unweeded control	7.60	22.76	31.57	768	2581	4420	1.060	2.968	1.120
	S.Em ±	0.05	0.10	0.10	4.65	9.60	11.29	0.010	0.021	0.027
	CD at 5%	0.14	0.30	0.29	13.81	28.53	33.54	0.029	0.062	0.081

DAT - Days after transplanting

Table 4: Effect of herbicides and crop weed competition on Crop growth rate (CGR g m^{-2} day^{-1}) and net assimilation rate (NAR mg m^{-2} days^{-1}) at different stages in brinjal

Sl. No.	Treatments	CGR (g m^{-2} day^{-1})			NAR (mg m^{-2} days^{-1})		
		30 DAT	60 DAT	90-120 DAT	30 DAT	60 DAT	90-120 DAT
1	Alachlor @ 1.0 kg a.i. ha^{-1}	3.17	8.22	2.91	48.14	42.07	10.57
2	Alachlor @ 1.5 kg a.i. ha^{-1}	3.26	8.42	2.96	48.37	42.21	10.64
3	Butachlor @ 1.0 kg a.i. ha^{-1}	2.70	7.29	2.70	47.38	40.96	10.41
4	Butachlor @ 1.5 kg a.i. ha^{-1}	2.78	7.43	2.74	47.88	41.34	10.51
5	Pendimethalin @ 1.0 kg a.i. ha^{-1}	3.26	8.40	2.94	48.38	42.15	10.62
6	Pendimethalin @ 1.5 kg a.i. ha^{-1}	3.33	8.51	2.96	48.51	42.28	10.63
7	Pretilachlor @ 1.0 kg a.i. ha^{-1}	2.67	7.20	2.66	47.77	41.00	10.32
8	Pretilachlor @ 1.5 kg a.i. ha^{-1}	2.72	7.29	2.69	48.01	41.10	10.39
9	Weed free check	3.56	8.93	3.04	49.45	42.87	10.65
10	Unweeded control	2.36	6.60	2.49	46.85	40.87	10.28
	S.Em +	0.02	0.05	0.06	0.49	0.30	0.22
	CD at 5%	0.06	0.14	0.18	NS	0.90	NS

DAT – Days after transplanting NS – Non-significant

81.

Channappagoudar, B. B., Biradar, N. R., Bharmagoudar, T. D. and Koti, R. V. 2007. Influence of Herbicides on Morpho-physiological Growth Parameters in Potato, Karnataka *J. Agric. Sci.* **20(3):** 487-491.

Channappagoudar, B. B, Biradar, N. R., Bharmagoudar, T. D. and Koti, R. V. 2007., Crop Weed Competition and Chemical Control of Weeds in Potato, Karnataka *J. Agric. Sci*. **20(4):** 715-718.

Dakshinadas, D. S. 1962. Mode of action of plant growth regulator type weedicides - A review. *Indian J. Agron.* **6**: 233-244.

Evans, G. C. 1972. The Quantitative Analysis of Plant Growth, Blackwell Science Publication, Oxford, p. 115.

Gautam, K. C. 1985. Studies on weed control in potatoes. Annu. Conf. *Indian Soc. Weed Sci.* 17-18.

Gregory, F. G. 1926. The effect of climatic conditions on the growth of barley. *Ann. Bot*. **40:** 1-26

Hilli, L. V. and Santlemann, P. V. 1969. Comparative effect of annual weeds on spanish peanut. *Weed Sci.* **17:** 1-2.

Jaiswal, V. P. 1994. Different response of weed species to herbicides in potato. *J. Indian Potato Assoc*. **21:** 157-159.

Melinda, D. and Eva, L. 2002. Influence of soil herbicides on the growth of potato. Proceedings of the 7th Hungarian Congress on Plant Physiology, **46(3-4):**197-198, Acta Biologica Szegediensis.

Mani, V. S., Malla, M. L., Gautam, K. C. and Bhagwndas 1973. Weed killing chemicals in potato cultivation. *Indian Farm.*, **VXXII:** 17-18.

Murthy, Y. V. N. 1982. Studies on weed control efficiency of certain herbicides of groundnut under different phosphorus levels. *M. Sc. (Agri.) Thesis*, Andhra Pradesh Agric. *Univ., Hyderabad (India).*

Nadagouda, B. T. 1995. Integrated weed management in drill sown onion (*Allium Cepa* L.). *M. Sc. (Agri.) Thesis*, Univ. *Agric. Sci., Dharwad, Karnataka (India)*

Nekar, M. 1997. Integrated weed management in garlic (*Allium Cepa* L.) in Northern transition tract of Karnataka. *M. Sc. (Agri.) Thesis*, Univ. *Agric. Sci., Dharwad, Karnataka (India).*

Noda, K., Ozarva, K. and Lakari 1968. Studies on the damage to rice plants due to competition. *Bull. Kyushu Agric. Expt. Stat.* **13:** 345-361.

Patel, N. M., Shah, P. M. and Patel, P. N. 1995, Comparative effect of different herbicides in potato Cv. Kufri Badshah. *J. Indian Potato Asso.* **22(1-2):** 74-76.

Power, J. F., Willis, W. O., Gunes, D. L. and Peichman, G. A. 1967. Effect of soil temperature, phosphorus and plant age on growth analysis of barley. *Agron. J.* **59:** 231-234.

Radford, P. J. 1967. Growth analysis formulae-their use and abuse. *Crop Sci*. **7:** 171-175.

Sestak, Z., Catsky, J. and Jarvis, P. G. 1971. Plant photosynthetic production, Manual of Methods, Ed. by Junk, W. N. V, publications, The Hughus, pp. 343-381.

Singh, M. N. and Lallan, B. 1987. Morphological parameters influencing potato yield in eastern plain in India. *J. Indian Potato Asso.* **14**: 154.

Watson, D. J. 1956. Leaf Growth in Relation to Crop Yield Ed. F. L. Milthrope, Butterworths Scientific publications London, pp. 178-191.