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STUDY OF WEED MANAGEMENT PRACTICES ON GROWTH, ROOT NODULATION AND YIELD COMPONENTS OF VEGETABLE COWPEA [*VIGNA UNGUICULATA* (L.) WALP.]

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ABSTRACT
An experiment was conducted to examine the effect of various weed control practices on growth, nodulation and pod yield of vegetable cowpea during post monsoon season of 2013. The treatments comprised of T_1: Weedy check, T_2: Weed free, T_3: Pendimethalin 30EC @ 1kg ai./ha, T_4: Pendimethalin 30EC @ 1kg ai./ha + one hand weeding, T_5: Quizalofop-ethyl 5EC @ 0.05kg ai/ ha, T_6: Quizalofop-ethyl 5EC @ 0.05kg ai/ha + one hand weeding, T_7: Black polyethylene mulch and T_8: Slashed grass mulch, which were laid out in Randomized Complete Block Design with four replications. Significant variations for weed population and dry matter accumulation, crop growth parameters and yield attributing traits were observed under influence of different weed control measures. Lowest number of weeds and weed dry weight as well second highest WCE (99.1%) were recorded with polyethylene mulch (T_7) followed by quizalofop-ethyl @ 0.05 kg ai/ha + 1 HW(T_6), whereas, in weed free plot no any weeds were recorded and expressed 100% WCE. Highest value of growth, yield attributes and pod yield (9.29 t/ha) recorded in plot treated with slashed grass mulch (T_8). It was observed that presence of weeds caused approximate 35.60% reductions in pod yield in comparison to weed free situation.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp.) is one of the most important legume vegetables as well as pulse grown in India. It is a warm season crop of humid tropics and sub tropical zones, well adapted to many areas of the country including North East India. It is grown for its long, green vegetable pods, seeds and foliage for fodder. In India, cowpea is grown on about 0.5 million ha with an average productivity of 600 to 750 kg grains/ha (Meena *et al.*, 2010). Weeds are a permanent constraint to crop productivity in agriculture. They are plant, which compete for nutrients, space, light, moisture and exert a lot of harmful effects by reducing the quality as well as quantity of the crop if the weed populations are left uncontrolled (Singh and Sheoran, 2008). In cowpea, yield losses due to weeds may ranges from 10-82% depending upon the density and species of weed, duration of infestation and competing ability of crop plants under different agroecological regions (Rao, 1994). Appropriate weed management practice is one of the most important components of improved production technology for obtaining higher crop yield with maximum benefit (Anwar *et al.*, 2004). In India, hand weeding is widely used for weed management. It is a laborious, time consuming and expensive method. Use of suitable herbicide provides more effective and efficient weed control. Beneficial effects of black polyethylene mulch in different crops have also been reported (Mamkagh, 2009). Hence, the present investigation was undertaken to evaluate the efficacy of chemical, physical and cultural method of weed control and to determine the most economical method of weed control in vegetable cowpea.

MATERIALS AND METHODS

A field study was conducted at vegetable farm of College of Horticulture and Forestry, Central Agricultural University, Pasighat, East Siang, Arunachal Pradesh during cropping season of 2013. The soil of the experimental site was sandy loam with a pH of 5.5. Eight weed control treatments comprising of viz. T_1: Weedy check (control), T_2: Weed free, T_3: Pendimethalin 30EC @ 1kg ai. /ha, T_4: Pendimethalin 30EC @ 1kg ai. /ha + one hand weeding, T_5: Quizalofop-ethyl 5EC @ 0.05kg ai/ ha, T_6: Quizalofop-ethyl 5EC @ 0.05kg ai/ ha + one hand weeding, T_7: Black polyethylene mulch and T_8: Slashed grass mulch were evaluated in Randomized Complete Block Design (RCBD) with four replications. Bush type cowpea variety VRCP-4 developed from IIVR, Varanasi (U.P.) was shown on 6th August, 2013 at 50x20 cm row to row and plant to plant spacing, respectively, using 70 kg seed/ha. Recommended dose of fertilizers (20 kg N, 50 kg P_2O_5 and 30 kg K_2O /ha) were applied to crop at the time of sowing through di-ammonium phosphate (DAP) and muriate of potash (MOP). Various weather parameters were recorded during crop growing period. The crop in its life cycle experienced 958.87 mm rainfall, 256.3 mm evaporation, relative humidity 77 to 81.1 % and the maximum and minimum temperature in the range of 26 to 28.6 and 20.2 to 23 ^{0}C, respectively. A pre-emergence herbicide (Pendimethalin 30 EC) was applied on

next day of sowing and post emergence application of Quizalofop-ethyl 5EC was done 20 DAS with the help of knapsack sprayer fitted with flat fan nozzle.

The observations on weeds (dry weight, and weed control efficiency) and crop were recorded. Pods were harvested from net plot in six pickings. The data on individual major weed species present in experimental field were recorded 60 days after sowing by placing 0.25 m^2 quadrate. Weed count was expressed as number/m^2. The data on weed subjected to square root transformation $\sqrt{(x+0.5)}$ to normalize their distribution. These samples were dried in hot air oven at 65°C till a constant weight was obtained. The dry matter was then computed in terms of g/m^2. Weed control efficiency was calculated using weed dry weight data at 60 DAS which was maximum during weed growth period. The growth, yield parameters and yield of cowpea were recorded from five randomly selected plants in each plot. Economics was calculated taking into consideration prevailing market prices of inputs output. The data for different parameters were statistically analyzed by following the methods as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Influence on weed spectrum and growth

The crop was infested with *Cynodon dactylon*, *Ipomoea* , *Echinochloa crusgalli*, *Cyperus rotundus*, *Urena lobata*, *Cyperus esculentus*, *Murdania kiosak*, *Commelina bengalensis*, *Ageratum coinzoides*, *Euphorbia hirta*, *Setaria glauca*, etc. species of weeds. All the weed control treatments proved effective in significantly reducing the number and dry weight of weeds as compared to weedy check at 60 days after sowing (Table 1). Black polyethylene mulch was quite effective in reducing the number and dry weight of weeds, which could be attributed to poor light conditions and physical suppression of the weeds (Kumar and Singh, 2013; Ramakrishna *et al.,* 2006). In plot provided with black polyethylene mulch the weeds emerged from holes where the seeds were inserted. The highest number of weed (79.87/m^2) and weed dry weight (10.03 g/m^2) were recorded in weedy check plots, whereas, the lowest weed number (01/m^2) and weed dry weight (0.087 g/m^2) were recorded with use of black polyethylene mulch.

Application of quizalofop-ethyl 5EC @ 0.05 kg a.i./ha supplemented with one hand weeding at 40 days stage significantly reduced the number and dry weight of weeds in comparison to other herbicidal treatments as well as use of slashed grass mulch. This was due to efficient control of weeds in the early stage of crop and at later stage be sequential weeding. Slashed grass mulch significantly reduced number and dry weight of weeds at 60 days in comparison to weedy check, PE application of pendimethalin @ 1kg a.i./ha alone or in combination with one hand weeding and quizalofop-ethyl @ 0.05 kg ai. Placement of slashed grass mulch on ground surface creates mechanical hindrance which does not allow the weed seeds to germinate and as a result reduced dry weight of weeds was observed.

Weed control efficiency (WCE) varied appreciably under various weed management practices. Weed free plot resulted in higher weed control efficiency (100 %) followed by black polyethylene mulch (99.1 %), POE application of quizalofop ethyle @ 0.05 kg ai/ha couple with one hand weeding (75.32 %) and slashed grass mulch (73.39 %). However, in comparison with other herbicides, pendimethalin @ 1 kg ai/ ha alone or in combination with hand weeding and quizalofop ethyle alone also registered notable values of weed control efficiency. Lesser weed germination and infestation by restricting the penetration of solar radiation under black polythene mulch resulted in higher weed control efficiency.

Influence on crop growth, root nodulation, yield and yield components

The maximum plant height (61.74 cm) was recorded in plots mulched with slashed grass followed by black polyethylene mulch (59.88 cm), weed free plot (58.07 cm) and plot treated with Quizalofop-ethyl 5EC + one hand weeding (56.50 cm) (Table 1). This might be due to enhanced beneficial bacteria and nutrients in the soil covered with mulch (Singh *et al.*, 2010). Plant height recorded in plots treated with pendimethalin 30 EC alone, Quizalofop-ethyl 5EC alone and Pendimethalin 30 EC couple with one hand weeding were statistically at par to each other but significantly superior over weedy check. The minimum plant height (45.09 cm) was recorded in weedy check plot.

Maximum number of leaves per plant was achieved from slashed grass mulch plot but remained at par with black

Table 1: Influence of weed management practices on crop growth and weed

Treatments	Plant height at last picking stage	No of green leaf/ plant (60DAS)	Stem girth (cm)	primary Branches /plant (60 DAS)	Secondary Branches /plant (60 DAS)	No of weeds (m^{-2})	Weed dry weight (g m^{-2})	WCE (%)
T1	45.09	38.09	10.77	4.6	3.6	8.96*(79.88)	3.24 (10.03)	0
T2	58.07	42.24	13.96	8.67	7.65	0.71(0)	0.71 (0)	100
T3	51.44	40.15	12.05	5.7	4.85	5.48(29.53)	2.11 (3.95)	60.54
T4	54.72	40.78	13.35	7.15	6.2	4.5(19.76)	1.96 (3.36)	66.45
T5	53.16	40.00	12.31	6.15	5.3	4.63(20.96)	1.94 (3.29)	67.18
T6	56.50	41.39	13.91	7.82	6.87	3.82(14.10)	1.72 (2.47)	75.32
T7	59.88	43.11	14.09	9.0	8.2	1.03(0.58)	0.76 (0.087)	99.13
T8	61.74	44.98	14.29	9.62	8.3	4.33(18.26)	1.78 (2.67)	73.39
CV %	6.13	6.49	5.06	5.82	6.37	2.32	2.43	2.32
SEd	2.39	1.90	0.47	0.30	0.29	0.068	0.030	1.11
CD (p=0.05)	4.97	3.95	0.97	0.63	0.60	0.143	0.063	2.31

*Transformed data $\sqrt{(x+0.5)}$, data in parentheses are original value

Table 2: Influence of weed management practices on root nodulation, flowering and green pod yield of vegetable cowpea

Treatments	Root nodulation /plant At flowering stage	Days to 50% flowering	Pod yield (t/ha)	% yield increase over control
T1	5.22	34.75	5.77	0
T2	10.07	37.25	8.96	55.49
T3	8.91	35.12	7.07	22.72
T4	9.43	35.62	8.47	47.05
T5	9.25	35.25	7.39	28.91
T6	10.05	35.87	8.91	54.40
T7	10.28	38	9.07	57.50
T8	11.25	38.37	9.29	61.18
CV %	6.53	2.45	6.59	22.10
SEd	0.43	0.63	0.38	6.39
CD (p = 0.05)	0.89	1.30	0.79	13.29

polyethylene mulch, weed free plot and plot treated with Quizalofop-ethyl 5EC along with one hand weeding. Since plants in weedy check plot were smaller therefore, these plots produced lower number of leaves/ plant while other plots had increased number of leaves due to lower competition of weeds. Similar trends were recorded in case of stem girth at 40 days stage. The number of primary (9.62) and secondary branches (8.30) /plant recorded from slashed grass mulch plot was the highest but that was statistically at par with the black polyethylene mulched plots. However, it was significantly different from the lowest primary (4.6) and secondary (3.6) number of branches recorded from the weedy check (Table 1).

Weed management practices had a notable impact on root nodulation. Better growth attributes induced higher accumulation and translocation of photosynthates to different plant parts, which helped the plants to develop more nodules (Choudhary *et al.*, 2012). More number of nodules recorded in plots treated with slashed grass mulch followed by black polyethylene mulch and weed free plots (Table 2).

The highest number of days to 50% flowering recorded from the plots that applied with slashed grass mulch (38.37) followed by black polyethylene mulch plot (38.00) and weed free plot (37.25) (Table 1). This may be due to more availability of nutrients to crops resulting in delayed flowering.

Weed control treatments brought about significant variation on pod yield (Table 2). All weed control treatments were significantly superior to weedy check in influencing pod yield. Application of slashed grass mulch, black polyethylene mulch and weed free treatments being statistically similar with each other were the superior in influencing pod yield. Slashed grass mulch treated plot recorded 61.18 % higher pod yield over weedy check. Choudhary and Kumar (2014) also recorded 18-35 percent higher maize yield from mulched plots. Similar results were also reported by Awasthy *et al.* (2014). Use of black polyethylene mulch, weed free treatments and application of quizalofop-ethyl 5 EC + one hand weeding increase the pod yield by 57.50 %, 55.49 % and 54.40 %, respectively. Vos and Sumarni (1997) also reported that crop under black polythene mulch and paddy straw mulch had higher chlorophyll content which enhances the carbon dioxide and other gasses exchange and ultimately leads to higher photosynthesis and transpiration. Therefore, dry matter accumulation and partitioning was better at different plant parts and enhanced crop growth parameters and yield than other mulches.Mulching avoided the fluctuations in temperature in upper soil depth. This favored root development resulted more availability of nutrients to plants could be associated with higher number of leaves. This higher number of leaves could have made way for greater reception of light which encouraged photosynthetic process of plants which was required for pod filling and improved yield. The results are analogous to those reported by Das *et al.* (2010).

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