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EFFECT OF INTEGRATED WEED MANAGEMENT PRACTICES ON WEED DYNAMICS, GROWTH AND YIELD OF CHICKPEA (*CICER ARIETINUM* L.)

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ABSTRACT
A field experiment was conducted at Agriculture Research Station, Annigeri, University of Agricultural Sciences, Dharwad during *Rabi* season of 2015-16 to find out most suitable integrated weed management practices for control of weeds in chickpea under rainfed condition. Among integrated weed management practices, application of pendimethalin @ 1.0 kg a.i ha^{-1} as pre-emergence followed by imazethapyr @ 75 g a.i ha^{-1} at 20 DAS as post-emergence followed by hoeing at 40 DAS (T_{10}) recorded significantly the lowest weed density (8.09, 6.14 and 3.78 m^{-2}) at 20 DAS, 40 DAS and at harvest, respectively, which resulted in lowest dry weight of weeds (3.58, 3.34 and 1.81 g m^{-2}) at 20 DAS, 40 DAS and at harvest, respectively and highest weed control efficiency (70.56 and 92.78 %) at 40 DAS and at harvest, respectively. Further, this treatment also recorded significantly the higher plant height (32.83 cm), primary branches (3.20 $plant^{-1}$), number of pods (34.13 $plant^{-1}$), Seed weight (8.35g $plant^{-1}$), B:C ratio (1.44) and seed yield (745 kg ha^{-1}).

INTRODUCTION

Chickpea (C*icer arietinum* L.) is one of the most ancient and extensively grown pulse crops of India. It contains high level of protein (20-22%), fat (4.5%), phosphorus (168 mg per 100 g), minerals (3-5%) and carbohydrate (61-65%). In spite of the importance of this crop in our daily diet average productivity of this crop is very low in India. Chickpea is generally grown on marginal and sub-marginal soils under rainfed conditions without proper weed management practices (Solh and Pala, 1990), although couple of inter-cultivations are followed by most farmers, but these practices do not control weeds effectively. Weed management is an important key factor for enhancing the productivity of chickpea, as weeds compete severely with crop for nutrient, moisture, light and space and result in 17-75 per cent reduction in the yield (Chaudhary *et al*., 2005). Weeds emerge with crop and create severe competition unless controlled timely and effectively. The initial 60 days period is considered to be the critical for weed-crop competition in chickpea (Singh and Singh, 1992).Competition of weeds with chickpea assumes more importance as the crop is sown during post-rainy season under rainfed and dryland conditions, thus requires timely and effective weed management practices. Hence, this investigation was taken with an objective to find out most suitable integrated weed management practice for control of weeds in chickpea. This paper deals with the objective of to study the effect of different integrated weed management practices on weed flora, effect of different weed management practices on growth and yield of chickpea.

MATERIALS AND METHODS

A field experiment was conducted at Agriculture Research Station, Annigeri, University of Agricultural Sciences, Dharwad during *Rabi* season of 2015-16 under rainfed condition. The experiment was laid out in a randomized complete block design (RCBD) with three replications and 12 treatments comprising, T_1 - Hoeing twice at 20 and 40 DAS, T_2 - Pendimethalin @ 1.0 kg a.i ha^{-1} (PE) + Hoeing twice at 20 and 40 DAS, T_3 - Quizalofop-p-ethyl @ 40 g a.i ha^{-1} at 20 DAS (POE), T_4 - Imazethapyr @ 75 g a.i ha^{-1} at 20 DAS (POE), T_5 - T_3 + Hoeing at 40 DAS, T_6 - T_4 + Hoeing at 40 DAS, T_7 - Pendimethalin @ 1.0 kg a.i ha^{-1} (PE) + T_3, T_8 - Pendimethalin @ 1.0 kg a.i ha^{-1} (PE) + T_4, T_9 - Pendimethalin @ 1.0 kg a.i ha^{-1} (PE) + T_3 + Hoeing at 40 DAS, T_{10} - Pendimethalin @ 1.0 kg a.i ha^{-1} (PE) + T_4 + Hoeing at 40 DAS, T_{11} - Weedy check and T_{12} - Weed free. The soil of the experimental field was clayey in texture and soil in low, low and high rating for available nitrogen (224 kg N ha^{-1}) (Kjeldal method), available phosphorus (20.86 kg P_2O_5 ha^{-1}) (Olesen's method) and available potassium (342 kg K_2O ha^{-1}) (Flame photometric method), respectively. The soil was found slightly alkaline (pH 7.95) (Potentiometric method) with normal electric conductivity. The seed of chickpea JG-11 variety was sown on 7th October, 2015 at row spacing of 37.5 x 10 cm with using 50 kg ha^{-1} seed rate and fertilized with 25 kg N, 50 kg

P_2O_5 and 25 kg K_2O ha^{-1}. The crop was grown with recommended package of practices of Agriculture Research Station, Annigeri, for Northern Dry Zone (zone-3) of Karnataka. Pre and post-emergence herbicide spray was done using 500 liters of water per hectare as per treatments. The data on weed population and weed dry weight were transformed by using $\sqrt{(x+0.5)}$ transformation to make analysis of variance valid as suggested by Gomez and Gomez (1983).

RESULTS AND DISCUSSION

Effect on weeds

The predominant weed flora of the experimental field comprised of *Cyperus rotundus* L. (53.67%), *Panicum dichotomiflorum* L. (14.38%), *Commelina benghalensis* L.(11.93%), *Convolvulus arvensis* L. (9.25%), *Euphorbia geniculata* L. (6.33%) and *Parthenium hysterophorus* L. (4.25%). Among the different weeds *Cyperus rotundus, Panicum dichotomiflorum* and *Commelina benghalensis* were dominant than others. Similar finding were reported by Goud *et al.*, 2013 and Chandrakar *et al.*, 2015. A perusal of the data on weed density and dry weight of weeds indicated that all integrated treatments significantly reduced the weed density and weed dry weight of weeds over weedy check at all stages of observation (Table 1). As expected weedy check (T_{11}) recorded significantly highest total number of weeds (11.42, 13.04 and 13.19 m^{-2}) and dry weight of weeds (5.13, 6.06 and 6.28 g m^{-2}) at 20 DAS, 40 DAS and at harvest, respectively. Among integrated weed management treatment, weed free check (T_{12}), which recorded significantly lowest total number of weeds (2.21, 1.79 and 1.34 m^{-2}) and lowest dry weight of weeds (1.26, 1.19 and 0.97 g m^{-2}) at 20 DAS, 40 DAS and at harvest, respectively, but integrated weed management treatments T_{10}, T_9 and T_2 found to be at par with weed free check (T_{12}). The remarkable reduction in weed density and dry weight of weeds at different stages might be due to effective of control weeds in respective treatments by manual weeding in weed free check and pre emergence herbicide at early growth stage of crop and post emergence herbicide along with hoeing at peak growth stage of crop which helped in maintain the weed population at low competition level and hoeing which also helped in weed management and soil moisture conservation. These results are in line with Buttar *et al.* (2008) and Goud *et al.* (2013). Various weed management treatment showed better weed control efficiency. Highest weed control efficiency was recorded in weed free check (T_{12}) at 40 DAS and at harvest, followed by T_{10}, T_9 and T_2. The higher weed control efficiency in these treatments could be attributed to effective control of weeds by hand weeding, hoeing, application of pre-emergence and post-emergence herbicide along with hoeing. These results are in conformity with findings of Chaudhari *et al.* (2016) and Goud *et al.* (2013).

Table 1: Effect of different weed management treatments on weed density, dry weight of weeds and weed control efficiency (%) at different growth stages of chickpea

Treatment	Weeds density (m^{-2})			Dry weight of weeds (g m^{-2})			WCE (%)	
	20 DAS	40 DAS	At harvest	20 DAS	40 DAS	At harvest	40 DAS	At harvest
T_1- Hoeing twice at 20 and 40 DAS	11.42*(130.00)	8.15*(66.00)	5.16*(26.33)	4.99*(24.43)	3.85*(14.33)	2.26*(4.60)	60.12	88.22
T_2- Pendimethalin @ 1.0 kg a.i ha^{-1} (PE) + T_1	8.49(72.00)	7.51(56.00)	4.69(21.67)	3.61(12.57)	3.52(11.87)	2.10(3.93)	67.26	89.90
T_3 - Quizalofop-p-ethyl @ 40 g a.i ha^{-1} at 20 DAS (POE)	11.23(125.67)	8.94(79.67)	9.42(88.33)	4.87(23.23)	4.07(16.10)	4.29(17.90)	55.63	54.09
T_4 - Imazethapyr @ 75 g a.i ha^{-1} at 20 DAS (POE)	11.11(123.00)	8.41(70.33)	8.93(79.33)	4.84(22.97)	3.92(14.87)	4.21(17.20)	58.98	55.89
T_5 - T_3 + Hoeing at 40 DAS	11.14(124.00)	8.90(79.00)	5.21(26.67)	4.82(22.87)	4.08(16.17)	2.22(4.43)	55.44	88.62
T_6 - T_4 + Hoeing at 40 DAS	11.32(127.67)	8.26(68.33)	5.21(26.67)	4.98(24.37)	3.86(14.47)	2.26(4.60)	60.24	88.18
T_7 - Pendimethalin @ 1.0 kg a.i ha^{-1} (PE) + T_3	8.74(76.00)	7.57(57.00)	6.69(47.67)	3.62(12.63)	3.64(12.77)	3.89(14.73)	64.76	62.35
T_8 - Pendimethalin @ 1.0 kg a.i ha^{-1} (PE) + T_4	9.06(81.67)	6.98(48.33)	7.26(52.33)	3.66(12.93)	3.63(12.67)	3.58(12.33)	64.94	68.37
T_9 - T_2 + Hoeing at 40 DAS	8.59(73.33)	6.49(41.67)	4.52(20.00)	3.64(12.73)	3.41(11.10)	2.10(3.90)	69.27	90.01
T_{10} - T_8 + Hoeing at 40 DAS	8.09(65.00)	6.14(37.33)	3.78(14.00)	3.58(12.33)	3.34(10.67)	1.81(2.83)	70.56	92.78
T_{11} - Weedy check	11.42(130.00)	13.04(169.67)	13.19(173.67)	5.13(25.87)	6.06(36.27)	6.28(39.00)	-	-
T_{12} - Weed free	2.21(4.67)	1.79(3.00)	1.34(1.33)	1.26(1.11)	1.19(1.00)	0.97(0.44)	97.22	98.87
S.Em±	0.31	0.36	0.47	0.15	0.12	0.11	1.63	1.25
CD (5%)	0.92	1.06	1.40	0.45	0.35	0.33	1.79	3.67

Note: DAS- Days after sowing, PE- Pre-emergence, POE- Post-emergence, * Transformed values [$\sqrt{(x + 0.5)}$], Figures in the parenthesis indicate original values

Table 2: Effect of different weed management treatments on growth and yield components of chickpea

Treatment	Plant height (cm)	Primary branches (plant^{-1})	Number of pods plant^{-1}	Seed weight (g plant^{-1})	Test weight (g/ 100 seed)	Seed yield (kg ha^{-1})	Net return (Rs. ha^{-1})	B:C ratio
T_1- Hoeing twice at 20 and 40 DAS	30.73	3.00	30.58	7.21	23.07	669	6701	1.35
T_2- Pendimethalin @ 1.0 kg a.i ha^{-1} (PE) + T_1	31.47	3.13	32.08	7.72	23.50	688	5827	1.28
T_3 - Quizalofop-p-ethyl @ 40 g a.i ha^{-1} at 20 DAS (POE)	27.87	2.40	25.00	5.52	22.58	554	3593	1.20
T_4 - Imazethapyr @ 75 g a.i ha^{-1} at 20 DAS (POE)	28.23	2.53	25.26	5.60	22.75	560	3863	1.22
T_5 - T_3 + Hoeing at 40 DAS	29.10	2.73	29.83	7.02	23.08	641	5979	1.32
T_6 - T_4 + Hoeing at 40 DAS	29.37	2.80	30.01	7.08	23.10	661	6772	1.36
T_7 - Pendimethalin @ 1.0 kg a.i ha^{-1} (PE) + T_3	28.83	2.60	26.00	5.83	22.92	583	3436	1.18
T_8 - Pendimethalin @ 1.0 kg a.i ha^{-1} (PE) + T_4	28.93	2.53	27.17	6.20	22.97	596	3985	1.21
T_9 - T_2 + Hoeing at 40 DAS	31.70	3.13	33.26	8.01	23.55	703	7057	1.35
T_{10} - T_8 + Hoeing at 40 DAS	32.83	3.20	34.13	8.35	23.67	745	8724	1.44
T_{11} - Weedy check	27.30	2.13	24.00	5.35	22.55	519	2874	1.17
T_{12} - Weed free	34.30	3.53	35.83	8.72	23.92	782	8122	1.37
S.Em±	0.98	0.14	1.76	0.41	0.26	37	1364	0.07
CD (5%)	2.88	0.41	5.17	1.21	0.77	109	4000	0.21

Effect on crop

Growth attributes

Plant height and number of primary branches per plant were significantly influenced due to weed management treatments at harvest (Table 2). The weed free check (T_{12}), which recorded significantly higher plant height (34.30 cm) and primary branches (3.53 plant^{-1}), which might be due to very less competition by weeds for nutrients, moisture and space resulted in better crop growth, but integrated weed management treatments T_{10}, T_9 and T_2 found to be at par with weed free check (T_{12}). Similar finding were reported by Goud *et al*. (2013) and Singh *et al*. (2014).

Seed yield and yield attributes

Yield and yield components of chickpea varied significantly among various weed management treatments (Table 2). As expected weed free check (T_{12}), which recorded significantly higher number of pods (35.83 plant^{-1}), seed weight (8.72 plant^{-1}), test weight (23.92 g) and seed yield (782 kg ha^{-1}), but integrated weed management treatments T_{10}, T_9 and T_2 found to be at par with weed free check (T_{12}). Significantly higher number of pods, seed weight, test weight and grain yield in these treatments was mainly due to lower weed dry weight and minimum crop-weed competition during the crop growth period due to pre and post-emergence application of herbicide along with hoeing. This enabled the crop to utilize nutrients, moisture, light and space to maximum extent. The results are in agreement with Singh *et al*. (2003), Punia *et al*. (2011) and Singh *et al*. (2014).

Economics

The net return and B:C ratio varied with the different treatments (Table 2). Among integrated treatments, application of pendimethalin @ 1.0 kg a.i ha^{-1} (PE) fb imazethapyr @ 75 g a.i ha^{-1} at 20 DAS (POE) fb hoeing at 40 DAS recorded the highest net return (Rs. 8724 ha^{-1}) and B:C ratio (1.44) than other treatments. The higher net return and B:C ratio in this treatment could be attributed to higher grain yield and lower cost of cultivation of this treatment. Similar finding were reported by Buttar *et al*. (2008). Based on results of the field experimentation, it seems quite logical to conclude that profitable, potential production and effective weed control in chickpea can be achieved by application of pendimethalin @ 1.0 kg a.i ha^{-1} (PE) fb imazethapyr @ 75 g a.i ha^{-1} at 20 DAS (POE) fb hoeing at 40 DAS during crop growth period, another alternative are application of pendimethalin @ 1.0 kg a.i ha^{-1} (PE) fb Quizalofop-p-ethyl @ 40 g a.i ha^{-1} at 20 DAS (POE) fb hoeing at 40 DAS and - Pendimethalin @ 1.0 kg a.i ha^{-1} (PE) fb hoeing twice at 20 and 40 DAS.

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