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Effect of integrated weed management practices on growth and yield of rainfed pigeonpea (*Cajanus cajan* (L.) Millsp.)

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Abstract
A field experiment was conducted during *kharif,* 2016 at Agronomy Farm, College of Agriculture, Dhule. To evaluate the optimum doses and efficacy of new molecules of herbicides used alone or in combination with cultural methods for better management of weeds in pigeonpea. Ten treatment were replicated thrice in Randomized Block Design (RBD). Significantly higher seed and straw yield of pigeonpea was recorded in the integrated weed management treatment which received application of pendimethalin @ 1.0 kg ha^{-1}as PE + imazethapyr 35 EC + imazamox 35 EC @ 0.075 kg ha^{-1} (20 DAS) *fb* HW at 40DAS (2215 and 5610 kg ha^{-1}, respectively). Growth parameters viz., plant height (215.12 cm), number of primary branches (19.10), total dry matter (203.14 g plant^{-1}) and yield parameters like number of pods plant^{-1}(160 plant^{-1}) and 100 seed weight (9.99 g) of pigeonpea were also increased significantly with pendimethalin @ 1.0 kg ha^{-1}as PE + imazethapyr 35 EC + imazamox 35 EC @ 0.075 kg ha^{-1} (20 DAS) *fb* HW at 40DAS as compared to weedy check. Combination of pre and post emergence herbicides along with manual method of weed control has resulted in significant increase in growth and yield of pigeonpea.

Keywords: Effect of integrated weed, practices on growth, rainfed pigeonpea

Introduction
Pigeonpea is the second most important pulse crop in India, only next to chickpea, in respect of both area and production. It is mainly a *kharif* crop, but can also be grown in winter (*rabi*) season. It occupies 4.75 million hectare area in world producing 3.68 million tons with average productivity of 722 kg ha^{-1} during 2014. In India, area and production of pigeonpea is 36.3 lakh hectare and 27.6 lakh tons, respectively with average productivity of about 760.33 kg ha^{-1} during *kharif*- 2014. In Maharashtra, the area and production of pigeonpea is about 12.37 lakh ha and 4.44 lakh tons respectively, with average productivity of 359 kg ha^{-1} during 2016. Heavy weed infestation is one of the major constraints that limit the productivity of pigeonpea crop. Among the factors responsible for low yields, severe infestation by weeds due to rainy season, slow initial growth and sowing at wider row spacing is observed in pigeonpea which results in low grain yield. Reduction in seed yield due to weeds in pigeonpea to the tune of 80 per cent has been reported [1]. This situation has necessitated the search of integrated weed management for effective and economic weed control in pigeonpea. As the weeds interfere during the harvesting of the crop, post emergence herbicides at about 20-30 DAS + hand weeding may help in avoiding the problem of weeds at later stages. Under this situation, managing weeds through integrated weed management will be an ideal means for controlling the weeds in view of their economics and effectiveness in pigeonpea. So in order to widen the weed control spectrum, it is imperative to use combination of integrated weed management treatment having different mode of action [2, 3, 4].

Methodology
A field experimental was undertaken during *kharif* season of 2016 at Agronomy Farm, College of Agriculture, Dhule. The soil was black cotton soil having pH 7.5 and organic carbon 0.70 per cent. The available nitrogen, phosphorus and potassium contents were 163.97, 11.52 and 351.45 kg ha^{-1}, respectively. The experiment with ten treatment combinations were laid out in randomized block design in three replications with gross and net plot size of 6.00 x 5.40 m^2 and 5.20 x 3.60 m^2, respectively.

The ten treatment consisted of weed free, weedy check, pendimethalin @ 1.0 kg ha^{-1} as PE *fb* HW at 40 DAS, pendimethalin @ 1.0 kg ha^{-1} as PE *fb* HW at 20 and 40 DAS, imazethapyr 35 EC + imazamox 35 EC @ 0.075 kg ha^{-1} at 20 DAS *fb* HW at 40 DAS, quizalofop ethyl 100 g ha^{-1} (20 DAS) *fb* HW at 40 DAS, pendimethalin @ 1.0 kg ha^{-1} (3 DAS) + quizalofop ethyl @ 100 g ha^{-1} (20 DAS) *fb* HW at 40 DAS, pendimethalin1.0 kgha^{-1}(3 DAS) + quizalofop ethyl @ 100 g ha^{-1} (20 DAS), pendimethalin @ 1.0 kg ha^{-1}as PE + imazethapyr 35 EC + imazamox 35 EC @ 0.075 kg ha^{-1} (20 DAS) *fb* HW at 40DAS and pendimethalin @ 1.0 kg ha^{-1} as PE + imazethapyr 35 EC + imazamox 35 EC @ 0.075 kg ha^{-1} (20 DAS). Pigeonpea variety 'Vipula' was sown at 90 x 20 cm were sown on 04th July 2016. Harvesting of Pigeonpea on 15th December 2016. At the time of sowing of pigeonpea 25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1} were applied through urea and singal super phosphate (SSP).

Table 1: Effect of different weed management practices on growth and yield parameters of pigeonpea

Treatment	Plant height at Harvest	No. of primary branches at Harvest	Total dry matter production (g) at Harvest	No. of pods plant^{-1}	100 seed weight (g)	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1: Weed free	216.33	19.23	205.50	162	10.0	2400	6000
T_2: Weedy check	152.32	5.5	78.33	90	9.51	890	1513
T_3: Pendimethalin @ 1.0 kg ha^{-1} as PE fb HW at 40 DAS	172.78	14.04	151.02	128	9.72	1440	3024
T_4: Pendimethalin @ 1.0 kg ha^{-1} as PE fb HW at 20 and 40 DAS	215.01	18.90	202.31	158	9.95	2173	5560
T_5: Imazethapyr 35 EC + Imazamox35 EC 0.075 kg ha^{-1} at 20 DAS fb HW at 40 DAS	193.28	16.80	176.90	143	9.82	1735	3817
T_6: Quizalofop ethyl 100 g ha^{-1} (20 DAS) fb HW at 40 DAS	171.68	13.28	149.28	125	9.69	1360	2856
T_7: Pendimethalin @ 1.0 kg ha^1(3DAS)+ Quizalofop ethyl @ 100 g ha^{-1} (20 DAS) fb HW at 40 DAS	194.12	17.01	177.28	144	9.83	1806	3974
T_8: Pendimethalin 1.0 kg ha^{-1} (3DAS) + Quizalofop ethyl @ 100g ha^{-1} (20 DAS)	172.48	13.58	150.20	127	9.71	1390	2919
T_9: Pendimethalin @ 1.0 kg ha^{-1} as PE + Imazethapyr 35 EC + Imazamox 35 EC @ 0.075 kg ha^{-1} (20 DAS) fb HW at 40DAS.	215.12	19.10	203.14	160	9.99	2215	5610
T_{10}: Pendimethalin @ 1.0 kg ha^{-1} as PE + Imazethapyr 35 EC + Imazamox 35 EC @ 0.075 kg ha^{-1} (20 DAS).	172.92	14.28	151.28	129	9.74	1460	3066
S.E.(m) ±	6.61	0.56	7.53	4.32	0.02	80	160
C.D. at 5 %	19.64	1.67	22.38	12.86	0.06	238	476
General mean	187.60	15.17	164.52	136.40	9.79	1687	3834

* DAS= Days after Sowing, PE= Pre-emergence, POE= Post emergence, *fb*=followed by

Results and Discussion

Effect on growth parameters

Weed free and weedy check treatments recorded significantly higher and lower growth parameters viz. plant height, number of primary branches and total dry matter production. Among integrated weed management treatments, application of pendimethalin @ 1.0 kg ha^{-1}as PE + imazethapyr 35 EC + imazamox 35 EC @ 0.075 kg ha^{-1} (20 DAS) *fb* HW at 40DAS (T_9) recorded significantly higher plant height (215.12 cm), number of primary branches (19.10) and total dry matter production (203.14 g plant^{-1}) and it was found statistically at par with treatment pendimethalin @ 1.0 kg ha^{-1} as PE *fb* HW at 20 and 40 DAS (T_4) (215.01 cm, 18.90 and 202.31 g plant^{-1}, respectively) (Table 1). Increase in growth parameters was due to the reduced weed infestation in early stage of crop and resulted in less competition between crop and weed for growth factors. All these have to be enabled the crop to draw more nutrients and moisture during pre-flowering stage finally leading to more primary branches per plant [5]. This is in line with the findings of [6-9].

Effect on yield and yield parameters

Weed free and weedy check treatments recorded significantly higher and lower yield and yield attributing parameters. Among integrated weed management treatments, significantly higher seed and straw yield was recorded in treatment which received application of pendimethalin @ 1.0 kg ha^{-1}as PE + imazethapyr 35 EC + imazamox 35 EC @ 0.075 kg ha^{-1} (20 DAS) *fb* HW at 40DAS (T_9) (2215 and 5610 kg ha^{-1}, respectively) (Table 1). Significantly higher seed and straw yield in these treatments were attributed due to application of herbicide controlled the weeds in early stages of crop and followed by hand weeding at 40 DAS efficiently controlled post emergence weeds in later stages and it has created a congenial conditions for crop to come up well under weed free situation and resulted in higher yield. This was evidenced from the findings of [5, 6, 8] Higher nutrient uptake by crop due to selective nature of herbicide during early growth stage of the crop minimized the crop-weed competition [10]. Thus crop plants might have used available resources effectively throughout the crop growth stages resulting in higher seed and straw yield. Results obtained in this study are in conformity with findings of [11]. Yield parameters like number of pods per plant and 100 seed weight were significantly higher in treatment which received application of pendimethalin @ 1.0 kg ha^{-1}as PE + imazethapyr 35 EC + imazamox 35 EC @ 0.075 kg ha^{-1} (20 DAS) *fb* HW at 40DAS (160 plant^{-1} and 9.99 g, respectively). It was due to higher primary branches having more flowers per plant and resulted in more pod formation plant^{-1}. This also confirms the earlier findings of [7].

The higher 100 seed weight is due to more seed size as evidenced by better utilization of resources by the crop, because of weed suppression [12]. Pigeonpea yields can be increased significantly to the tune of 30 percent more by adopting this combination of cultural method with integrated weed management treatments at right time of crop growth.

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