

Original Research Article

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Effect of Integrated Weed Management on Growth, Yield, Yield Attributes and Economics of Grain Amaranth (*Amaranthus hypochondriacus* L.) under South Gujarat Condition

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ABSTRACT

Keywords

Grain amaranth, Weed management, Economics, Oxyfluorfen, Oxadiargyl, Fenoxyp prop ethyl

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Field experiment was conducted on dark brown soil of the college farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during rabi season of 2016-2017 to study the effect of integrated weed management on growth, yield, yield attributes and economics of grain amaranth (*Amaranthus hypochondriacus* L.) Production potential, higher profit and effective weed control in grain amaranth can be achieved by maintaining weed free through hand weeding throughout crop growth period, where labours are easily available. In case of labours scarcity, application of oxyfluorfen 50g/ha PE fb fenoxyp prop ethyl 50g/ha PoE at 40 DAS also equally effective.

Introduction

Amaranth is one of the few C₄ crop species other than grasses. Amaranth is a quick growing multipurpose crop suitable for poor soils of semi-arid and seasonal wet areas. This crop is highly resistant to extreme stress conditions.

Grain amaranth (*Amaranthus hypochondriacus* L.) is a potential upcoming subsidiary food crop, considered by many as crop of the future. Green leaf of amaranth is used as vegetable for human being and fodder

for animals. The grains of this crop are used in quality human diet. Protein content in grains varies from 11-13 % and the quality of protein is equivalent to fish protein. It is observed that seeds of *A. cruentus* L. *A. hypochondriacus* L. contained higher crude protein (16.86 %), moisture (11.88 %), crude fat (4.30 %), crude fibre (2.90 %), ash (2.10 %), carbohydrates (63.13 %), calcium (169.63 mg/100 g), iron (10.42 mg/100 g), phosphorus (395.33 mg/100 g) (Munjali *et al.*, 1999). Medicinal point of view the amaranth is also important. The tocopherol fraction of amaranth oil contains important cholesterol lowering agents, some

of which could be useful in treating cardiovascular disease. Amaranth grain can be used as popcorn, making sweets, biscuits, pastry etc.

There are several factors responsible for retarding the production and productivity of grain amaranth. Among which, weed infestation is reported to cause yield losses. Yield losses due to weed competition vary considerably depending on the level of weed infestation and weed species prevailing. Nevertheless, almost all values reflect the seriousness of the weed problem.

Besides, weeds consume more labours, as well as increase the cost of production. However, recently the adopting of integrated weed management, inclusive application of herbicide and cultural practices has been found more effective in control of weeds (Arya, 2004).

Materials and Methods

An experiment was conducted on College Farm, Navsari Agricultural University, Navsari during *rabi* season of 2016-17. Twelve treatments comprising of weed management practices *viz.*, T₁: Weed Free, T₂: One hand weeding at 20 DAS, T₃: Two hand weeding at 20 DAS and 40 DAS, T₄: Oxyfluorfen 50 g/ha PE, T₅: Oxadiargyl 50 g/ha PoE at 20 DAS, T₆: Fenoxyprop ethyl 50 g/ha PoE at 20 DAS, T₇: Oxyfluorfen 50 g/ha PE *fb* Oxadiargyl 50 g/ha PoE at 40 DAS, T₈: Oxyfluorfen 50 g/ha PE *fb* Fenoxyprop ethyl 50 g/ha PoE at 40 DAS, T₉: Oxyfluorfen 50g/ha PE + One hand weeding at 40 DAS, T₁₀: Oxadiargyl 50 g/ha PoE, 20 DAS + One hand weeding at 40 DAS, T₁₁: Fenoxyprop ethyl 50 g/ha PoE, 20 DAS + One hand weeding at 40 DAS, T₁₂: Weedy check; were evaluated in randomized block design with three replications. The soil of the experimental field was clayey in texture, low in available

nitrogen (191 kg/ha) and medium in available phosphorus (32 kg/ha), fairly rich in available potash (358 kg/ha), slightly alkaline in reaction (pH 7.9) and having well drainage with good moisture retention capacity. The Grain amaranth cv. G A 2 was sown on 21st November, 2016 and harvested on 29nd February 2017.

The crop was fertilized with 60 kg N and 40 kg P₂O₅/ha. Observation regarding to the growth parameters *i.e.* plant height (cm) at 30 DAS, 60 DAS and at harvest, Length of main inflorescence (cm), Number of lateral spikelets per spike. Observation regarding to yield and yield attributes *i.e.* test weight (g/cc), grain and stover yield (kg/ha) and harvest index. The data were analyzed procedures described by Panse and Sukhatme (1985).

Results and Discussion

Effect of weed management on growth parameters

It is evident from the data presented in (Table 1) that the initial as well as at harvest plant population was not influenced significantly by various weed management treatments. Further, the results indicated that there was no adverse effect on germination and establishment of grain amaranth crop due to pre and post emergence application of herbicides during the course of investigation.

Data shows that the significantly higher plant height (68.6 and 183.3 cm) was observed under T₁ (weed free) which was statistically at par with treatment T₈, T₃, T₇ and T₁₀ at 60 DAS and at harvest, respectively and At 30 DAS, plant height fails to reach at significantly level due to different weed management treatment. The significantly lower plant height (53.1 and 154.4 cm) was recorded under T₁₂ (weedy check) at 60 DAS

and at harvest, respectively. The increase in plant height at periodical growth stage under weed free condition during critical crop competition period might be due to effective control of weeds under these treatments, which improved growth of crop and checked nutrients drain by weeds.

The shortest plant height might be due to severe competition by weeds for moisture and nutrients; consequently, the plant growth was affected. Significant improvement in growth characters also might be due to increase water and nutrient uptake, which might have accelerated photosynthetic rate, thereby increasing the supply of carbohydrates, resulted in increased cell division, multiplication and elongation leading to increase the higher plant growth.

Treatment T₁ (weed free) proved better than other herbicides as well as weedy check. Suppressed weed allowed more light, moisture, nutrients and space to crop plant, which resulted in better growth characters. Similar results were also reported by Singh *et al.*, (2017) and by David (1997)

Effect on yield and yield attributes

The entire yield attributes namely Length of main inflorescence (cm), number of lateral spikelets per spike, grain yield (kg/ha), stover yield (kg/ha), harvest index (%) and test weight showed significant response to weed management practices but harvest index (%) (Table 2). The significantly longer main inflorescence (84.28 cm) was recorded in treatment T₁ (weed free) which was statistically at par with treatment T₈, T₃, T₇, T₁₀, T₆, and T₁₁ at harvest. The weed control treatments failed to exert its significant effect on Number of lateral spikelets per spike and harvest index. The higher test weight value (0.90 g/cc) observed under treatment T₁ (weed free) which was statistically at par with

treatment T₈, T₃ and T₇. Numerically maximum number of lateral spikelets per spike and harvest index was observed under weed free treatment while minimum in weedy check treatment. The higher grain and stover yield (1296 and 3156 kg/ha) was recorded under the weed free treatment (T₁).

The treatment T₈ in which pre emergence application of Oxyfluorfen 50 g/ha *fb* post emergence application of Fenoxyprop ethyl 50 g/ha at 40 DAS was at par with T₃, T₉, and T₁₁. The magnitude of increase in grain yield under treatment T₁ was to the tune of 57.09 % over weedy check (T₁₂), while 54.69 % in T₈, 50.40 % in T₃ and 45.05 % increase in T₁₁ over weedy check. The per cent increase in stover yield due to weed free condition (T₁) was to the tune of 54.24 % over weedy check (T₁₂), while 52.84 % increase in T₈, 49.80 % increase in T₃, 43.76 % increasing in T₉ and 42.49 % increase in T₁₁ over unweeded treatment (T₁₂).

The reason for the increase in grain yield was mainly due to weed free condition provided at critical crop weed competition period, which might be due to effective control of weeds under these treatments. Grain yield is primarily a function of accumulation of photosynthates resulted in growth and increase yield attributes. Therefore, it can be inferred that significant improvement in these parameters contributed towards higher grain yield. The yield loss study also shows that reduced weed population initially by pre-emergence herbicide followed by weed control around 25 to 30 DAS either by post emergence herbicide or hand weeding has less reduction in yield. This result indicated that appreciable increase in grain and stover yield could be the significant improvement in plant growth in terms of plant height under those treatments. Similar effect was also reported by Patel *et al.*, (2012), Shukla *et al.*, (2014) Gaharwar *et al.*, (2017).

Table.1 Effect of weed management on growth parameters of grain amaranth

Treatment		Plant population per net plot area		Plant height (cm)		
		Initial (30 DAS)	At harvest	30 DAS	60 DAS	At Harvest
T₁	Weed free	269.9	264.2	23.43	68.6	183.3
T₂	One hand weeding at 20 DAS	275.1	268.2	22.33	57.3	159.8
T₃	Two hand weeding at 20 DAS and 40 DAS	280.3	273.6	23.34	67.4	180.1
T₄	Oxyfluorfen 50g/ha PE	267.6	261.7	22.41	56.0	159.5
T₅	Oxadiargyl 50g/ha PoE at 20 DAS	277.7	271.6	21.35	53.4	158.5
T₆	Fenoxo prop ethyl 50g/ha PoE at 20 DAS	278.7	271.7	22.47	59.0	161.0
T₇	Oxyfluorfen 50g/ha PE <i>fb</i> Oxadiargyl 50g/ha PoE at 40DAS	258.9	253.3	21.15	63.4	169.7
T₈	Oxyfluorfen 50g/ha PE <i>fb</i> Fenoxo prop ethyl 50g/ha PoE at 40 DAS	261.8	254.1	23.54	68.3	182.5
T₉	Oxyfluorfen 50g/ha PE + One hand weeding at 40 DAS	268.7	262.0	22.83	54.2	159.1
T₁₀	Oxadiargyl 50g/ha PoE, 20 DAS + One hand weeding at 40 DAS	277.6	271.3	22.31	61.5	163.4
T₁₁	Fenoxo prop ethyl 50g/ha PoE, 20 DAS + One hand weeding at 40 DAS	283.8	277.8	21.56	57.5	160.5
T₁₂	Weedy check	269.1	262.9	21.76	53.1	154.4
	S.Em. ±	5.11	5.39	1.20	2.55	6.72
	C.D at 5 %	NS	NS	NS	7.95	20.90
	C.V. %	3.25	3.51	9.28	7.38	7.01

Table.2 Effect of weed management on yield parameters and economics of grain amaranth

Treatment		Test weight (g/cc)	Yield(kg/ha)		Cost of cultivation (₹/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	B:C Ratio
			Grain	Stover				
T ₁	Weed free	0.90	1296	3156	17784	78409	60625	3.40
T ₂	One hand weeding at 20 DAS	0.71	874	2269	16360	52898	36538	2.23
T ₃	Two hand weeding at 20 DAS and 40 DAS	0.87	1121	2877	17072	67834	50762	2.97
T ₄	Oxyfluorfen 50g/ha PE	0.66	919	2412	14996	55593	40597	2.70
T ₅	Oxadiargyl 50g/ha PoE at 20 DAS	0.62	849	2111	14593	51385	36792	2.52
T ₆	Fenoxo prop ethyl 50g/ha PoE at 20 DAS	0.75	973	2459	15549	58862	43313	2.78
T ₇	Oxyfluorfen 50g/ha PE <i>fb</i> Oxadiargyl 50g/ha PoE at 40DAS	0.85	825	2072	15115	49895	34780	2.30
T ₈	Oxyfluorfen 50g/ha PE <i>fb</i> Fenoxo prop ethyl 50g/ha PoE at 40 DAS	0.88	1227	3062	16071	74242	58171	3.61
T ₉	Oxyfluorfen 50g/ha PE + One hand weeding at 40 DAS	0.63	1048	2568	17132	63403	46271	2.70
T ₁₀	Oxadiargyl 50g/ha PoE, 20 DAS + One hand weeding at 40 DAS	0.78	862	2185	16729	52141	35412	2.11
T ₁₁	Fenoxo prop ethyl 50g/ha PoE, 20 DAS + One hand weeding at 40 DAS	0.75	1012	2511	17685	61243	43558	2.46
T ₁₂	Weedy check	0.59	556	1444	14224	33964	19740	1.38
	S.Em. ±	0.03	69.61	154.74				
	C.D at 5 %	0.08	217	482	-	-	-	-
	C.V. %	6.21	12.51	11.04				

Sale price of grain amaranth 1. Grain - ₹ 60 /kg 2. Stover - ₹ 0.20/kg

Economics

Economics is the major consideration of farmers, while taking a decision regarding the adoption of the recently developed new technology. Hence the gross realization, net realization and benefit cost ratio were computed for different weed management treatments. Data presented in (Table 2) revealed that maximum gross returns and net return of (₹78409/ha and ₹60625/ha) was realized under the treatment T₁ (weed free), followed by treatment T₈ (₹ 74242/ha and ₹58171/ha) and T₃ (₹67834/ha and ₹50762/ha). The higher grain yields recorded under these treatments might be responsible for higher gross return. However, the maximum B: C ratio (3.61) was accrued under the treatment T₈ followed by T₁. The lowest gross return, net return and B: C was accrued under the treatment T₁₂ (₹33964/ha, ₹19740/ha and 1.38 respectively). So higher gross returns along with the lowest cost under T₁, T₈, T₃ treatments might be responsible for higher net return and B: C ratio. These findings are in close vicinity with those reported by Patel *et al.*, (2012), Shukla *et al.*, (2014), Gaharwar *et al.*, (2017).

Based on results of the field experiment, it seems quite logical to conclude that production potential, higher profit and effective weed control in grain amaranth can be achieved by maintaining weed free through hand weeding throughout crop growth period, where labours are easily available. In case of labour scarcity, application of oxyfluorfen 50g/ha PE fb fenoxyprop ethyl 50g/ha PoE at 40 DAS, also equally effective.

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