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Weed flora influenced by integrated weed management in grain amaranth (*Amaranthus hypochondriacus* L.)

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Abstract
An experiment was conducted to find out "Weed flora influenced by integrated weed management in grain amaranth (*Amaranthus hypochondriacus* L.)" at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *rabi* season of 2020-21. The treatments comprised of ten methods of weed management *viz*., Pendimethalin @ 400 g a.i./ha (PE), Pendimethalin @ 400 g a.i./ha (PE) and inter culturing *fb* hand weeding at 4 WAS, T_3- Oxadiargyl @ 50 g a.i./ha (PE), Oxadiargyl @ 50 g a.i./ha (PE) and inter culturing *fb* hand weeding at 4 WAS, Oxadiargyl @ 50 g a.i./ha (PoE) at 3 WAS, Oxyflurofen @ 50 g a.i./ha (PE), Oxyflurofen @ 50 g a.i./ha (PE) and inter culturing *fb* hand weeding at 4 WAS, Inter culturing fb hand weeding at 3 WAS, Weed free, Weedy check were evaluated in randomized block design with replicating thrice. Significantly lower population of weed as well as dry weight of weed were registered in weed free treatment which was closely followed by Oxyflurofen @ 50 g a.i./ha (PE) and interculturing *fb* hand weeding at 4 WAS. The maximum number of weed and dry weight of total weed were recorded under the treatment of weedy check at harvest. Weed free treatment noticed the minimum weed index and maximum weed control efficiency which was closely followed by the application of Oxyflurofen @ 50 g a.i./ha (PE) and interculturing *fb* hand weeding at 4 WAS.

Keywords: Integrated weed management, interculturing, grain amaranth, Oxyflurofen and oxadiargyl

Introduction
Grain amaranth (*Amaranthus hypochondriacus* L.) is also known as a pseudo-cereal. It is a one of the underutilizad, neglected and orphan crop with a high nutritive value. Amaranth are broad-leafed plants, one of the few non grasses that produces significant amount of edible "cereal" grain. It's seeds are very small, large inflorences and more seed per plant occurs. They grow vigorously resist drought, heat, pests and adapted readily to new environments. Amaranth is a beautiful crop with brilliantly colored leaves, stems and flower of purple, orange, red and green. Amaranth, as already noted are among the group of plants that carry on photosynthesis by the spealized C4 path-way they are one of the few C4 crop species that are not grasses. Amaranth grain has been reported to be more nutritive than the common food grains. It contains protein (16%) and amino acids like lysine (5%), cystine (2.9%), methionine (4.4%) and tryptophan (1.4%) in comparison to the cereal crops *viz*., barley, maize, rice and wheat. It is also a rich source of fat (7.1 g), moisture (9.3%), calcium (0.49 g), phosphorus (0.45 g), iron (22.4 g) and total food energy (391 calories) per 100 grams in comparison to common cereals. In India, presently amaranth is commonly grown in Gujarat, Arunachal Pradesh, Madhya Pradesh, Maharashtra, Himachal Pradesh, hills of Uttar Pradesh and some State of South India. In Gujarat, it is mainly grown in Banaskantha, Kheda, Mehsana, Sabarkantha, Patan, and some parts of Saurashtra region as a *rabi* crop. In Gujarat, it is grown on borders of the field of lucerne or cumin or taken as a mixed crop with mustard. In Gujarat, the estimated cultivated area of Grain amaranth crop is 12,000 ha during year 2016-17. In Banaskantha district, it is cultivated in estimated area 8,200 ha during year 2016-17 and total 93,694 quintals procurement production of grain Amaranth was recorded at APMC, Palanpur. (Prajapati *et al.*, 2019) [7].

Weeds are one of the most important biological constraints in agricultural production systems. Weeds are a serious constraint for production and easy harvesting in grain amaranth. Weed competes with the crop for moisture, nutrient, light and space. Yield losses may be less if only few weeds are present, but heavy infestations may cause complete crop failures and in some cases, when perennial weeds get established, the land cannot be used for crop production until the infestation has been controlled.

Various weed control measures *viz*. cultural, mechanical and chemical or their integrated approach are used, but integrated weed control provide elimination of a large number of weed flora and conserve of natural resources. In the view of increase in labour wages and scarcity of labour during peak season, integrated weed management could be a more effective and efficient alternative to hand weeding. 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) [1].

Materials and Methods

An experiment entitled on "Weed flora influenced by integrated weed management in grain amaranth" was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *rabi* season of 2020-21. The soil of experimental field was loamy sand in texture with low in organic carbon and available nitrogen (137.56 kg/ha), medium in available phosphorus (43.42 kg/ha) and high in available potassium (281.00 kg/ha) having pH value of 7.56. The present experiment comprising of ten treatments combinations *viz*., Pendimethalin @ 400 g a.i./ha (PE), Pendimethalin @ 400 g a.i./ha (PE) and inter culturing *fb* hand weeding at 4 WAS, Oxadiargyl @ 50 g a.i./ha (PE), Oxadiargyl @ 50 g a.i./ha (PE) and inter culturing *fb* hand weeding at 4 WAS, Oxadiargyl @ 50 g a.i./ha (PoE) at 3 WAS, Oxyflurofen @ 50 g a.i./ha (PE), Oxyflurofen @ 50 g a.i./ha (PE) and inter culturing *fb* hand weeding at 4 WAS, Inter culturing *fb* hand weeding at 3 WAS, Weed free and Weedy check. GA 6 variety of grain amaranth crop was grown with 45 cm spacing between the rows. The grain amaranth crop was fertilized with 60 kg nitrogen and 40 kg phosphorus per ha. Urea and DAP were used as a source for nitrogen and phosphorus, respectively. Total ten treatment combinations were tested in Randomized Block Design (RBD) with three replications. Pre-emergence herbicide was applied after sowing with required quantity were sprayed by knapsack sprayer with flat fan nozzle using 500 liters of water per hectare. All the recommended package of practices was followed for the crop. Weed density and weed dry matter per m^2 was recorded with the help of 0.5 x 0.5 m^2 quadrant at harvest. In order to draw a valid conclusion, the data of weed density and weed dry matter were subjected to square root transformation ($\sqrt{x} + 0.5$) as suggested by Gomez and Gomez (1984) [10] before statistical analysis. Weed Index (%) and Weed Control Efficiency (%) were worked out as per the formula suggested by Gill and Kumar (1969) [3] and Kondap and Upadhyay (1985) [4], respectively. The data were statistically analyzed for various characters as described by (Panse and Sukhatme, 1967) [6].

Results and Discussion

Data revealed that significantly lowest weeds (0.71) were found under weed free treatment. Among the integrated weed management treatments, the lowest number of total weed was observed under the treatment oxyflurofen @ 50 g a.i./ha (PE) and inter culturing *fb* hand weeding at 4 WAS (4.07) at harvest. However, the highest number of weeds (7.67) was observed under the weedy check treatment among all the treatments. The remarkable reduction in weed population might be due to effective weed management in respective treatments either by manual hand weeding or interculturing or pre emergence and post emergence herbicidal management or both. These findings are in conformity with results obtained by Shukla *et al.* (2014) [8] and Singh *et al*. (2017) [9].

Data pertaining to dry weight of weeds recorded at harvest indicated marked variation in dry weight of weed due to weed management practices. Among weed management practices, significantly lower quantity of dry weight of weeds (0.71 g/m^2) was recorded under weed free treatment and established its superiority over other weed management treatments. Beside weed free treatment, lower dry weight of weeds was observed in Oxyflurofen @ 50 g a.i./ha (PE) and inter culturing *fb* hand weeding at 4 WAS (4.81 g/m^2). Weedy check treatment recorded maximum weed dry weight (14.12 g/m^2) as compared to other weeding treatments at harvest. The lower dry weight of weeds might be due to lower weed population throughout the crop season with the adoption of regular hand weeding and interculturing or the application of pre-emergence herbicide which helped to stop weed emergence during early growth stage of crop. On the contrast, the highest dry weight of weeds recorded under unweeded condition might be due to higher weed population. The results were in conformity with the finding of Shukla *et al.* (2014) [8] and Singh *et al*. (2017) [9].

All the weed management practices except weedy check effectively controlled weeds at harvest. It was clear from the data that the maximum weed control efficiency (100.00 percent) was recorded by the weed free treatment which was closely followed by Oxyflurofen @ 50 g a.i./ha (PE) and interculturing *fb* hand weeding at 4 WAS treatment (88.62 percent). Among the single application of herbicide, application of Oxyflurofen @ 50 g a.i./ha (PE) recorded the maximum weed control efficiency. The maximum weed control efficiency under treatments weed free and Oxyflurofen @ 50 g a.i./ha (PE) and interculturing *fb* hand weeding at 4 WAS was due to elimination of weeds from the field since beginning and the weeds those escaped from herbicidal control were removed by interculturing and hand weeding. The combined effect of herbicide, hand weeding and interculturing resulted in remarkably lower weeds population and ultimately less dry weight of weeds observed under these treatments which were responsible for maximum weed control efficiency. The results of present study are in agreement with those reported by Mehriya *et al*. (2008) [5], Shukla *et al.* (2014) [8] and Singh *et al*. (2017) [9].

Keeping the plot weed free throughout the crop period recorded minimum weed index and it was followed by treatment of Oxyflurofen @ 50 g a.i./ha (PE) and interculturing *fb* hand weeding at 4 WAS (10.93 percent). The higher value of weed index with weedy check treatment was due to the weedy situation prevailing throughout the crop period, higher weed counts and higher dry weight of weeds. Effective management of the flushes of weeds by the application of Oxyflurofen @ 50 g a.i./ha (PE) and interculturing *fb* hand weeding at 4 WAS reduced weed count and dry weight of weeds (Table 1 and 2) resulted in higher grain yield (Table 2) and lower weed index. While more number of weeds under weedy check was responsible for higher dry weight of weeds which tended to increase the weed index. Similar findings were also reported by Shukla *et al.* (2014) [8] and Singh *et al*. (2017) [9].

Table 1: List of weed flora observed in experiment

Sr. No.	Local name	Scientific name	Family
[A]	**Grassy weeds**		
1.	Dharo	*Cynodon dactylon* L. Pers.	Gramineae
2.	Arotaro	*Digitaria sanguinalis* L. Scop.	Poaceae
[B]	**Broad leaved weeds**		
1.	Chill	*Chenopodium album* L.	Chenopodiaceae
2.	Dungaro	*Asphodelus tenuifolius* L. Cavan	Liliaceae
3.	Darudi	*Argemone mexicana* L.	Papaveraceae
4.	Dudheli	*Euphorbia hirta* L.	Euphorbiaceae
5.	Tandalja	*Amaranthus viridis* L.	Amaranthaceae
6.	Bhoi Amali	*Phyllanthus niruri* L.	Euphorbiaceae
7.	Kanjaro	*Digera arvensis* L. Forsk.	Amaranthaceae
8.	Bhoi pathri	*Launaea nudicaulis* L.	Asteraceae
9.	Ekdandi	*Tridax procumbens* L.	Asteraceae
10.	Satodi	*Trianthema portulacastrum* L.	Aizoceae
11.	Methyu	*Melilotus indica* L.	Fabaceae
[C]	**Sedge weeds**		
1.	Chidho	*Cyperus rotundus* L.	Cyperaceae

Table 2: Effect of integrated weed management on weed density, weed dry weight, weed control efficiency and weed index of grain amaranth

Treatments	Weed density (No. of weed/m^2)	Weed dry weight (g/m^2)	Weed control efficiency (%)	Weed index (%)
Pendimethalin @ 400 g a.i./ha (PE)	6.82^{bc} (45.95)	11.06^{b} (121.77)	38.52	44.39
Pendimethalin @ 400 g a.i./ha (PE) and interculturing *fb* hand weeding at 4 WAS	5.11^{d} (25.66)	5.59^{e} (30.78)	84.57	24.33
Oxadiargyl @ 50 g a.i./ha (PE)	6.64^{bc} (43.60)	10.11^{c} (101.78)	48.65	36.32
Oxadiargyl @ 50 g a.i./ha (PE) and interculturing *fb* hand weeding at 4 WAS	4.37^{e} (18.57)	5.35^{ef} (28.13)	85.84	19.81
Oxadiargyl @ 50 g a.i./ha (PoE) at 3 WAS	6.98^{b} (48.26)	11.45^{b} (130.64)	34.39	55.66
Oxyflurofen @ 50 g a.i./ha (PE)	6.28^{c} (38.91)	9.15^{d} (83.19)	58.13	32.58
Oxyflurofen @ 50 g a.i./ha (PE) and interculturing *fb* hand weeding at 4 WAS	4.07^{e} (16.10)	4.81^{f} (22.61)	88.62	10.93
Interculturing *fb* hand weeding at 3 WAS	5.35^{d} (28.16)	5.88^{e} (34.08)	82.81	28.29
Weed free	0.71^{f} (0.00)	0.71^{g} (0.00)	100.00	-
Weedy check	7.67^{a} (58.26)	14.12^{a} (198.98)	-	66.48
S.Em.±	0.16	0.24	-	-
C.D. (P=0.05)	0.47	0.73	-	-
C.V. %	5.10	5.45	-	-
Note: Figure in parentheses indicate original values of square root transformation.				

Fig 1: Grassy and sedge weeds observed at experimental site

Fig 2: Broad leaved weeds observed at experimental site

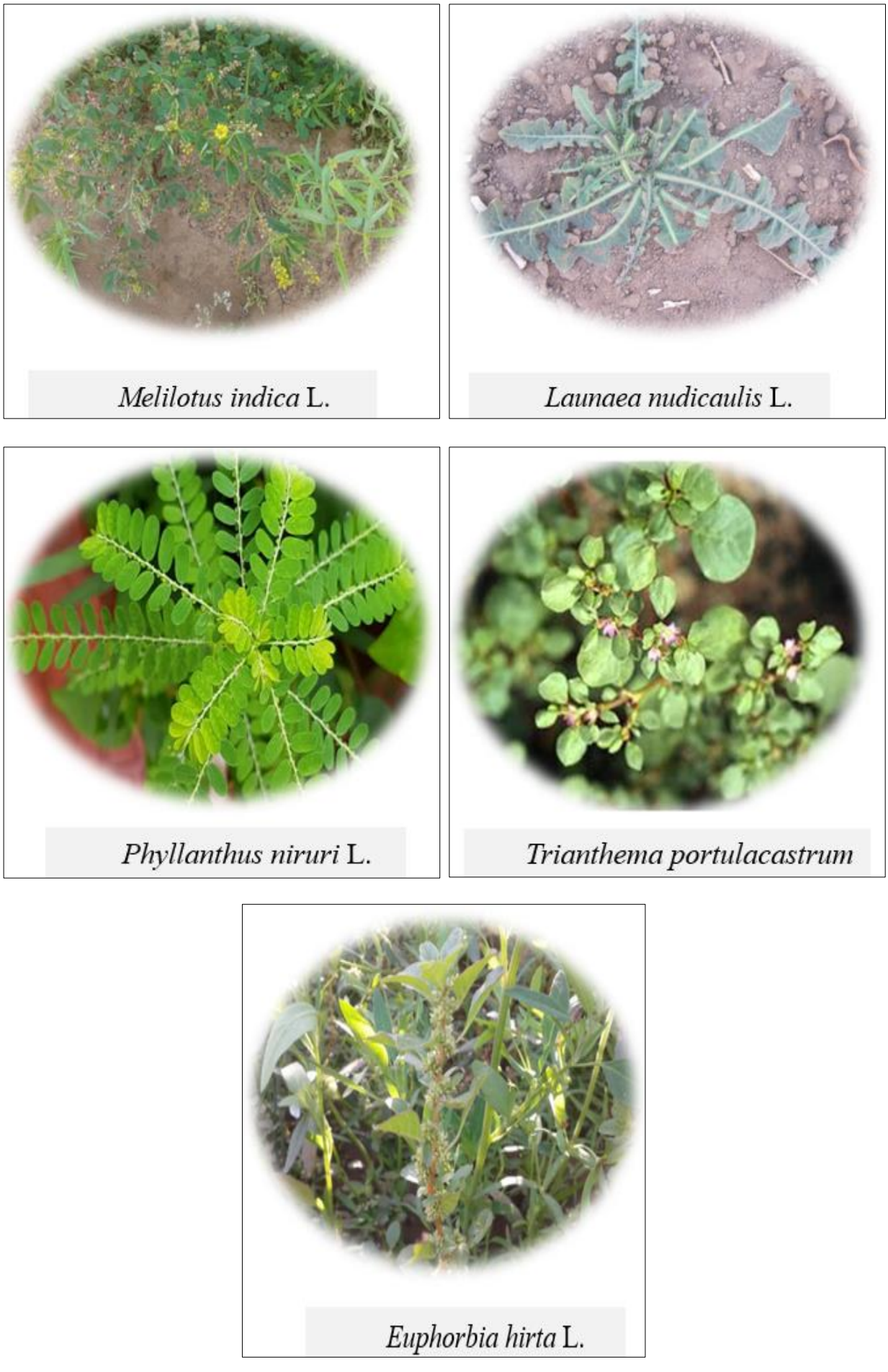

Fig 3: Broad leaved weeds observed at experimental site

Conclusion

From the result of one year experimentation it can be concluded the efficient weed management in grain amaranth can be achieved by maintaining weed free condition throughout crop growth period where labors are easily available. However, under the scarcity of labors, efficient weed management can be achieved with application of Oxyflurofen @ 50 g a.i./ha (PE) and interculturing fb hand weeding at 4 WAS.

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