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Influence of integrated weed management on production and quality in muskmelon seed (*Cucumis melo*)

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ABSTRACT Field experiment was carried out during two spring summer seasons to find out the effect of integrated weed management on seed yield and quality in muskmelon. Lowest weed density, weed dry weight and highest weed control efficiency (95.8%) was recorded with glyphosate 1.0% + hoeing compared to alachlor @ 1.0 kg/ha and pendimethalin @ 1.0 lit/ha supplemented with one hand weeding. Glyphosate 1.0% + hoeing recorded significantly higher seed yield than alachlor @ 1.0 lit /ha and pendimethalin @ 1.0 lit/ha supplemented with one hand weeding. Significantly higher values of seed germination, seedling length, seedling dry weight and seedling vigour indices, whereas significantly lower values of electrical conductivity (0.265 and 0.220 mS/cm/g) were observed in glyphosate 1.0% + hoeing and polythene mulch (700 µ) compared to one hand weeding and weedy check (0.432 and 0.458 mS/cm/g), respectively.

Key words: Cucurbit, integrated weed management, glyphosate, polythene mulch, shield, poly pots, germination, electrical conductivity

Spring summer crop of muskmelon grown in north India coincides with the time of prolific growth (600 to 800 shoots/m^2) of purple nut sedge (*Cyperus rotundus* L.). In addition to yield reductions due to competition for resources, weeds interfere with harvesting by making fruits difficult to find. Manual weeding fails to control the weed, under ground rhizomes give rise to new shoots is expensive. To control the purple nut sedge integrated weed management which includes chemical, mechanical, their combinations and mulch, is necessary because of the limited availability of registered, effective and selective herbicides. Glyphosate has been recommended to combat such perennial and persistent weed [1] under non-crop situations. Glyphosate shows no pre-emergence or residual soil activity [2]. The non-residual soil activity of glyphosate enabled to utilize this herbicide on weed foliage postemergently after covering the non-targeted plants (Muskmelon). Glyphosate being non selective to cucurbit crops and can kill them on contact. This necessitates the shielding of cucurbit plants by covering them with plastic pots.

Use of polythene mulches in the furrow and beds restricts the weeds to cross the barrier and it is destroyed beneath the mulch itself. Presence of weeds affects the seed quality by producing lowered seed test weight with reduced vigour [3]. Since no systemic information is available for integrated weed management in muskmelon the experiment was undertaken to evaluate the effect of different weed control treatments on seed yield and quality of muskmelon seeds.

MATERIALS AND METHODS

Field experiment was conducted at Indian Agricultural Research Institute, Regional Station, Karnal on muskmelon cv. 'Pusa Madhuras' during two spring seasons. The soil of experimental area was clay loam in texture having pH 7.8, organic carbon 0.55%, electrical conductivity 0.34 m mhos/cm and available N, P and K @180, 24 and 310

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kg/ha, respectively. The treatments comprising blanket spray of glyphosate 1% and 0.5 % on weed foliage after shielding the non targeted plants *i.e.* muskmelon plants + one hoeing near the plant base on 20 days from sowing (DFS), pendimethalin and alachlor 1.0 and 1.5 kg/ha followed by one hand weeding on 30 DFS, polythene mulch 700 µ and 400 µ, two hand weeding (One on 20 and 40 days from sowing) one hand weeding (20 days from sowing) and weedy check were tried in randomized block design with four replications. Muskmelon cultivar 'Pusa Madhuras' seeds were sown in furrow bed method *i.e.* seeds were sown on the top side of the furrow 50 cm apart and vines were allowed to trail on the raised bed (1.5 m wide on either side) on 10 and 14 March during subsequent years, respectively. Crop was uniformly fertilized with recommended dose of N, P and K. Muskmelon individual plants (At three to four leaf stage, 15 to 20 days from sowing) were fully covered/shielded with PVC pots (9" diameter). Blanket spray of 1.0 and 0.5% glyphosate (41 % SL) @500 l/ha was done on actively growing weed foliage.

Weed density was recorded in the quadrates of 1x1 m^2 randomly in each plot. Weed dry weight was recorded after drying the weed biomass in hot air oven at 70° ±1° C for 72 hr and reported as g/m^2. Seed was extracted manually from the fruits of each plot followed by washing, cleaning and air-drying. Seed germination (%) was recorded following ISTA rules [4]. After recording the germination, ten normal seedlings were randomly selected to measure its seedling dry weight, whereas seedling vigour was calculated following Abdul-Baki and Anderson [5].

RESULTS AND DISCUSSION

Weed density

The weed flora comprised of *Cyperus rotundus* (65%), *Trianthema portulacustrum (8%), Digitaria sanguinalis* (12%), *Parthenium hysterophorus* (3%) and *Coronopus dydimus* (7%) and other weeds (5%) which included *Cirsium arvensis, leptochloa chinensis* and *Cynodon dactylon.* The lowest density of *C. rotundus* was observed in polyethylene mulch 700 µ treatment as compared to 400 µ because the initial Cyperus blade was able to pierce the 400 µ polythene mulch. Among the herbicidal treatments, the spray of glyphosate 1.0 and 0.5% followed by hand weeding reduced *C. rotundus and other weeds* significantly as compared to pendimethalin and alachlor followed by hand weeding. Glyphosate being broad spectrum and shoot translocated herbicide destroy the roots and rhizomes of *C. rotundus.* Pendimethalin was effective for broad leaf weeds, whereas alachlor was effective towards grasses, however both the herbicides had little control on *C. rotundus.* Handweeding once or twice failed to control *C. rotundus* effectively which may be due to the presence of tubers, and rhizomes which give rise to new shoots within a day or two. Similar results have been reported by Chopra and Chopra [6].

Weed dry weight and weed control efficiency

Weeds accumulated maximum dry matter in weedy check due to uncontrolled weed growth and lowest in polythene mulch of 700 µ followed by glyphosate 1.0 and 0.5%. All the herbicidal, polythene mulch and hand weeding treatments reduced the weed dry weight significantly over (Weed) check. Among the two mulch treatments polythene mulch (400 µ) accumulated higher dry matter compared to plastic mulch of 700 µ. Glyphosate at both the doses recorded significantly lower weed dry weight compared to pendimethalin and alachlor (Table 1) which may be due to the lower control of *C. rotundus* and other weeds by pendimethalin and alachlor owing to their differential selectivity towards the present weeds. It was observed that since the field was infested dominantly with *C. rotundas*, hand weeding failed to control *C. rotundus*, as the new shoots from the rhizomes germinate in plenty and accumulated higher dry matter. Higher weed control efficiency of 95.7 and 85.9% was observed in glyphosate 1.0 and 0.5% compared to 65.8, 68.7 and 54.7% with pendimethalin and alachlor followed by one hand weeding and one hand weeding treatment, respectively (Table 1).

Seed mass

All the herbicidal treatments, mulch treatments and two hand weedings recorded significantly more 1000-seed mass as compared to check.

Table 1. Effect of integrated weed management on weed parameters and seed yield in muskmelon (Pooled data of 2 years)

Treatment	Weed density	Weed dry weight	WCE	1000-seed mass (g)	Seed yield (kg/ha)
Pendimethalin+*HW on 30 DFS	(98.5) 09.97	**(82.7) 09.13	65.8	26.044	108.9
Alachlor + HW30 DFS	(81.6) 09.07	(76.3) 08.74	68.5	26.759	109.9
Glyphosate (1%) + one hoieng	(59.2) 07.61	(10.0) 03.97	95.8	28.583	175.2
Glyphosate (0.5%) + one hoieng	(69.6) 07.80	(34.0) 05.88	85.9	27.421	141.6
Polythene Mulch (700 µ)	(4.50) 01.63	(05.2) 01.92	97.9	28.725	164.4
Polythene Mulch (400 µ)	(84.2) 07.92	(42.7) 06.29	82.4	27.925	129.2
One HW at 30 DFS	(198.1) 14.03	(109.6) 10.44	54.7	25.618	69.3
Two HW at 20 & 40 DFS	(112.7) 10.47	(47.3) 06.94	80.5	27.690	118.4
Weedy check	(329.6) 18.07	(242.2) 15.19	-	23.505	21.1
CD(P=0.05)	(39.42) 02.26	(66.8) 02.58		2.323	30.0

*Handweeding; **Figures in parentheses were original, whereas outside were transformed values to $\sqrt{X+1}$

Glyphosate 1.0 and 0.5% and polythene mulch treatments (700 µ and 400 µ) recorded 21.6, 16.6, 22.2 and 18.8% higher seed mass than weedy check which may be due to the reduced weed intensity. Pendimethalin+one hand weeding also recorded significantly lower 1000-seed mass compared to glyphosate 1.0% and polythene mulch 700 µ. Chopra *et al.* [3] also recorded lower seed size and 1000-seed weight under weed check conditions compared to weed free conditions. Weed free conditions ensured proper nutrition of mother crop and uptake of the available nutrients which translocated from vegetative parts to the reproductive parts resulting in production of bolder seeds.

Seed yield

Weed control treatments glyphosate 1.0%+ weeding and polythene mulch (700 µ) remained at par for seed yield, however both the treatments showed superiority over mulch (400 µ) and glyphosate (0.5 %+weeding). This may be attributed to lower dose of glyphosate and lower consistency of polythene mulch (Table 2). The reduction in seed yield was recorded under pendimethalin (37.8%) and alachlor (37.3%) compared to glyphosate (1.0%). Seed yield was reduced by 88.0 and 87.3% in weedy check compared to glyphosate (1.0 %) and polythene mulch (700 µ). Hand weeding twice could not record the seed yield at par with glyphosate 1.0% and polythene mulch (700 µ), however it was significantly higher than one hand weeding and weedy check.

Seed quality

Weed stress to the mother plants significantly affected the seed quality. The seed germination was 35.4% and 27.3% higher in polythene mulch 700 µ and glyphosate 1.0% compared to check which may be due to competition for resources by weeds resulting in lower photosynthetic activity and poor translocation of synthates for the developing seed. Germination percent among herbicidal, mulch and two hand weeding remained at par (Table 2). Vigorous, tall and heavy seedling resulted from polythene mulch and glyphosate treated plots than those to weed check and one hand weeding. The weed management treatments produced heavier seeds having more reserve food material resulting in increased seedling length and dry weight of seedling (Table 2). All the seed quality parameters indicate that vigour potential was maximum with

Table 2. Effect of integrated weed managememt on seed quality parameters in muskmelon seed (Pooled data of 2 years)

Treatment	Germination (%)	Seedling length (cm)	Seedling dry weight (mg)	Vigour index I	Vigour index II	Electrical conductivity (mS/cm/g)
Pendimethalin+HW on 30 DFS	83.7	24.4	12.8	2047	1062	0.375
Alachlor + HW on 30 DFS	83.0	24.7	12.9	2054	1066	0.377
Glyphosate (1%) + one hoeing	83.4	27.2	14.9	2292	1239	0.265
Glyphosate (0.5%) + one hoeing	87.2	25.7	14.7	2243	1282	0.312
Polythene mulch (700 µ)	88.7	28.4	14.6	2524	1288	0.220
Polythene mulch (400 µ)	84.2	27.1	14.7	2291	1236	0.295
One HW on 30 DFS	79.8	21.8	11.9	1736	923	0.432
Two HW on 20 & 40 DFS	86.7	25.5	13.8	2217	1180	0.335
Weedy check	65.5	18.6	10.2	1232	675	0.458
CD (P=0.05)	6.45	2.69	1.50	313	156	0.06

heavier seeds compared to light seeds. The vigour index of seeds was lower in seeds obtained from treatments under weed stress (Table 2). The seedling vigour index is indicative of quality of seed, which was being changed with weed stress possibly because of sharing of food, space and sunlight between mother crop and weeds. The results are in agreement to Chopra *et al.* [7].

Electrical conductivity

Lower values of electrical conductivity of seed leachete in weed control treatments like polythene mulch, glyphosate treated plots indicate the proper development of fruits and seeds, whereas significantly higher values of EC were recorded in weed check and one hand weeding. Dense weed foliage covers the wines resulting in poor pollination by insects and improper development of fruits and seeds. As electrical conductivity is positively correlated with other weed parameters like weed density and weed dry weight (Table 2) lesser the value higher is the probability of good quality of seeds. The difference in the loss of sugars from seeds of different transplanting dates may be due to difference in relative amount of sugars present in seed or due to difference in sensitivity to uptake of water during imbibitions or both.

Threat assessment of weeds to muskmelon seed yield and quality

Seed yield

Relationship between weed density and weed dry weight with seed yield of muskmelon fitted well with linear regression model. Seed yield was negatively correlated with weed density and weed dry weight, whereas positively co-related with weed control efficiency (Table 3). The negative correlation was due to the depletion of various inputs by weeds and thereby reducing their availability to muskmelon crop. The regression analysis showed reduction in seed yield, might be predicted to a tune of 0.469 kg/ha and 0.632 kg/ha (Table 3) with increase in one number of weed density and one gram of weed dry weight/m^2. Weed control efficiency (WCE) showed a highly significant positive correlation (0.95) with seed yield indicating the greatest effect of this attribute, which was due to the control of weeds by different weed control methods, consequently reducing the sharing of the inputs, and their increased availability for the crop. Increase in seed yield could be predicted to 1.582 kg/ha with increase in 1% of weed control efficiency.

Table 3. Relationship between weed parameters, seed yield and quality in muskmelon

Variable	Correlation coefficient	Regression equation	Coefficient of determination (R^2)
Weed density vs seed yield	–0.94	y = –0.4699x + 169.04	0.89
Weed density vs 1000-seed mass	–0.92	y = –0.0161x + 28.771	0.85
Weed dry weight vs seed yield	–0.95	y = –0.6326x + 160.90	0.91
Weed dry weight vs 1000-seed mass	–0.97	y = –0.0225x + 28.548	0.94
WCE vs seed yield	0.96	y = 1.5281x + 7.7715	0.92
WCE vs 1000-seed mass	0.97	y = 0.0541x + 23.125	0.94
Weed density vs germination	–0.93	y = –0.0678x + 90.265	0.87
Weed density vs seedling length	–0.96	y = –0.0305x + 28.331	0.92
Weed density vs seedling dry weight	–0.90	y = –0.0152x + 15.134	0.82
Weed density vs electrical conductivity	0.86	y = 0.0007x + 0.2598	0.75
Weed dry weight vs germination	–0.95	y = –0.0918x + 89.131	0.91
Weed dry weight vs seedling length	–0.96	y = –0.0406x + 27.767	0.92
Weed dry weight vs seedling dry weight	–0.95	y = –0.0212x + 14.928	0.91
Weed dry weight vs electrical conductivity	0.87	y = 0.0009x + 0.2724	0.76

Seed quality

Germination percent of mother seeds, seedling length and seedling dry weight were negatively correlated with weed density and weed dry weight, whereas electrical conductivity was positively correlated with weed parameters (Table 3). Reduction in germination percent, seedling length and seedling dry weight could be predicted to 0.07 & 0.09%, 0.03 & 0.04 cm and 0.01 & 0.02 mg with increase in one number, one gram of weed density and weed dry weight/m^2.

Thus, it can be concluded that weed stress to mother plants of muskmelon reduced the seed yield and quality. Application of glyphosate 1.0% after shielding the muskmelon plants with polypots, can be used successfully where *C. rotundus*, the dominating weed, was controlled efficiently which consequently increased the seed yield and quality.

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