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Short communication

Weed management in irrigated organic finger millet

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Finger millet (*Eleusine coracana* (L.) Gaertn.) ranks third in importance among millets in the country in both area (1.27 million ha) and production (1.91 million tonnes) after sorghum and pearl millet. It is commonly referred as ragi in Karnataka. It is one of the major staple foods of farming communities of southern Karnataka. Apart from human consumption, straw is also used as fodder for cattle and green straw is suitable for making silage.

Organic farming is being practiced in more than 130 countries of the world with a total area of 30.4 m ha (0.65% of the total agricultural land) with 0.7 million number of organic farmers world over (Willer 2008). It is gaining momentum in India owing to the concerns expressed on the safety of environment, soil, water and food chain. Cultivating crops organically, and at the same time maintaining higher production levels is a big challenge. Since chemical intervention is not permitted for weed management, non chemical weed management is the major limitation in field crops like ragi, paddy and other cereals under organic farming. A concern about the potential increase in weed population due to non use of herbicides is rated as serious problem in organic farming (Bond and Grundy 2001). Weeding through non-chemical means have to be undertaken within the critical period of the crop. Hence, the present study was initiated to find out effective and economical weed management practices in organic finger millet.

The field experiment was conducted during *Kharif* 2012 at the Main Research Station, Hebbal, Bengaluru, to identify the suitable methods of managing weeds in organic finger millet. It was laid out in randomized complete block design (RCBD) with three replications. The soil of the experimental field was sandy loam having pH of 6.55 with 236 kg N, 27.2 kg P_2O_5 and 176.2 kg K_2O/ha. The variety used for the experiment was '*GPU-28*'. The experiment comprised of twelve treatments, *viz.* T_1- passing wheel hoe at 20, 30 and 40 DAP, T_2- inter-cultivation twice at 20 and 35 DAP, T_3- stale seedbed technique, T_4- passing wheel hoe at 20, 30 and 40 DAP + one hand weeding at 45 DAP, T_5- inter-cultivation twice at 20 and 35 DAP + one hand weeding at 45 DAP, T_6- stale seedbed technique + inter cultivation twice at 20 and 35 DAP, T_7- organic mulching 10 t/ha after transplanting, T_8- growing cover crops (horse gram/cowpea) and mulching at 55 DAP, T_9- directed spray of *Eucalyptus* leaf extract on weeds, T_{10}- directed spray of cattle urine on weeds, T_{11}- hand weeding twice at 20 and 30 DAP, T_{12}- unweeded check.

Seedlings were raised in nursery bed of size 7.5 m long, 1.2 m width and 10 cm height prepared one month before transplanting of the crop. Nursery bed was prepared and the FYM was mixed with soil. Seeds 5 kg/ha were sown uniformly and light irrigation was given periodically. Neem cake was applied equivalent to 50 kg N/ha at the time of transplanting. Cattle urine was top dressed in three splits at 15, 30 and 40 DAP to meet remaining 50 kg N/ha. Stale seedbed treatment was initiated 15 days before transplanting of the crop. One irrigation was given to stale seedbed plots and weeds were allowed to germinate. The germinated weeds were removed by passing cultivator criss-cross one day before transplanting of the crop. Organic mulching was done with crop residues (paddy straw) and dried grasses 10 t/ha one week after transplanting. Seed mixture of cowpea and horse gram was sown in between two rows of finger millet. These cover crops were mulched between rows at 55 DAP.

Major weed flora observed in the experimental plot were: *Cyperus rotundus* L. among sedges; *Echinochloa colona* (L.), *Cynodon dactylon* (L.) Pers, *Dactyloctenium aegyptium* (L.) Beauv., *Digitaria marginata* (Retz.), *Eragrostis pilosa* (at initial stage) *Eleusine indica* (L.) Gaertn, (at later stages) among grasses; among broad-leaved weeds *Parthenium hysterophorus*, *Alternanthera sessilis*, *Sida acuta*, *Spillanthus acmella*, *Commelina benghalensis*, *Ageratum conyzoides*, *Ocimum canum*, *Cinebra didema. etc*. Similar findings have been reported by Kumar (2004).

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At 60 DAP, the total weed density and weed dry weight was significantly lower in hand weeding twice at 20 and 30 DAP (26.32 and 6.4 g/m^2) treatment and was on par with stale seed bed technique + inter-cultivation twice at 20 and 35 DAP (29.67 and 8.0 g/m^2) and T_1 + one hand weeding (41.26 and 10.7 g/m^2). Whereas, stale seedbed alone and spray of cattle urine on weeds were not significantly controled the total weed density, which were on par with unweeded control (279.68 and 95.1 g/m^2, respectively). At harvest, total weed density and weed dry weight was significantly lower in hand weeding twice at 20 and 30 DAP (22.60 and 9.4 g/m^2, respectively) and was at par with stale seedbed technique + inter cultivation twice at 20 and 35 DAP (23.90 and 10.3 g/m^2, respectively). All the weed management treatments recorded significantly lower total weed density at harvest except stale seedbed technique alone and spray of cattle urine on weeds which were at par with unweeded control (245.90 and 105.1 g/m^2, respectively).

Table 1. Total weed density and weed dry weight at different stages in finger millet as influenced by weed management practices

Treatment	Weed density (no./m^2)		Weed dry weight (g/m^2)	
	60 DAP	Harvest	60 DAP	Harvest
T_1	1.72 (50.2)	1.68 (46.4)	1.62 (39.7)	1.67 (44.7)
T_2	1.92 (80.9)	1.79 (59.0)	1.76 (55.8)	1.76 (55.7)
T_3	2.25 (177.5)	2.23 (166.8)	1.91 (80.0)	1.96 (89.9)
T_4	1.64 (41.2)	1.64 (41.8)	1.10 (10.7)	1.55 (33.3)
T_5	1.69 (47.3)	1.68 (45.5)	1.65 (42.9)	1.63 (40.6)
T_6	1.50 (29.6)	1.41 (23.9)	1.00 (8.0)	1.09 (10.3)
T_7	2.10 (124.0)	2.04 (108.5)	1.74 (52.4)	1.78 (58.4)
T_8	1.89 (76.0)	1.83 (65.1)	1.74 (53.5)	1.67 (44.3)
T_9	2.22 (165.5)	2.18 (149.5)	1.92 (81.3)	1.94 (86.0)
T_{10}	2.27 (185.8)	2.21 (160.0)	1.84 (67.7)	1.93 (82.2)
T_{11}	1.45 (26.3)	1.39 (22.6)	0.92 (6.4)	1.06 (9.4)
T_{12}	2.45 (279.6)	2.39 (245.9)	1.99 (95.1)	2.03 (105.1)
LSD (P=0.05)	0.20	0.19	0.06	0.11

Figures in parentheses are original values; data analyzed using transformation =log (x+2); Treatment details are given in materials and methods

The WCE was higher with hand weeding twice at different growth stage of the crop (92.8, 93.2 and 91.0 % at 30, 60 DAP and at harvest, respectively) owing to the fact that it produced lesser weed dry weight. Similar findings were observed by Kumar (2004) in groundnut-finger millet cropping system, who observed hand weeding twice to be the best treatment having the lowest WI, highest WCE and higher yield. WCE of stale seedbed technique combined with inter cultivation twice (91.3, 91.6 and 90.1% at 30, 60 DAP and at harvest respectively) and passing wheel hoe at 20, 30 and 45 DAP with one hand weeding (68.5, 88.7 and 68.3% at 30, 60 DAP and at harvest, respectively,). The results of this study were similar with earlier findings of Ramamoorthy *et al.* (2009) in finger millet and Sindhu *et al.* (2010) in wet seeded rice. Similar findings were also obtained by Mynavathi *et al*. (2008) in irrigated maize and found that passing wheel hoe significantly reduced the weed dry weight and increased the maize yield compared to other mechanical weeders.

Grain yield of finger millet was significantly higher in hand weeding twice at 20 and 30 DAP (5.46 t/ha) as compared to unweeded control. However, it was on par with stale seedbed technique + inter cultivation twice and also with passing wheel hoe at 20, 30 and 45 DAP + one hand weeding (5.36 t/ha). Similar findings were obtained by Ramamoorthy *et al.* (2009). This higher yield might be

Table 2. Weed control efficiency (%) at different growth stages and grain yield of finger millet as influenced by weed management practices

Treatment	WCE			Grain yield (t/ha)
	30 DAP	60 DAP	Harvest	
T_1	33.0	58.2	57.5	4.09
T_2	18.6	41.3	47.0	3.93
T_3	26.6	15.8	14.4	3.39
T_4	68.5	88.7	68.3	5.14
T_5	31.5	54.9	61.3	4.22
T_6	91.3	91.6	90.1	5.36
T_7	84.4	45.2	44.4	3.77
T_8	8.5	43.7	57.8	3.20
T_9	12.5	14.5	18.1	2.92
T_{10}	18.5	28.8	21.8	3.30
T_{11}	92.8	93.2	91.0	5.46
T_{12}	0.0	0.0	0.0	2.73
LSD(P=0.05)	-	-	-	0.95

due to better control of weeds at tillering stage of the crop resulted in higher yield of the crop. Whereas, lower grain yield (2.73 t/ha) was obtained in unweeded control. This reduction in yield might be due to highest competition with the finger millet throughout the crop growth period.

SUMMARY

A field experiment was conducted during *Kharif* season 2012 at the Main Research Station, Hebbal, Bengaluru, to know the effect of weed management practices on weed flora and weed growth in irrigated organic finger millet. All weed management treatments had significantly lower total weed density and weed dry weight as compared to unweeded control. Stale seed bed technique + inter cultivation twice at 20 and 35 DAP (23.9/m^2 and 10.3 g/m^2) significantly lowered the total weed density as well as weed dry weight and was at par with hand weeding twice at 20 and 30 DAP (22.6/m^2 and 9.4 g/m^2, respectively). Higher total weed density and weed dry weight was found in unweeded check (245.9/m^2 and 105.1 g/m^2). Highest weed control efficiency was found in manual weeding (93.2%) followed by stale seedbed combined with inter cultivation twice (91.6%) and passing wheel hoe twice with one manual weeding (88.7%). Grain yield was significantly higher in hand weeding twice (5.46 t/ha) followed by stale seedbed combined with inter cultivation twice (5.36 t/ha).

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