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Effect of Weed Management Practices and Fertility Levels on Growth and Yield Components in Finger Millet-Groundnut Cropping System

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Abstract

The hand weeding twice resulted in higher grain yield (3,450 kg/ha) of finger millet followed by butachlor and 2, 4-D Na salt at 0.75 kg/ha. The higher yield was reflected in terms of yield parameters such as ear length, 1,000 grain weight, number of fingers per ear head ear weight per plant and grain weight per plant. Unweeded control treatment caused significant reduction in these traits and consequently lowered the yield by 43% owing to weed competition. Similarly higher grain yields were recorded in the treatments which received 7.5 tonnes/ha of FYM along with recommended dose of fertilizer (100 : 50 : 50 kg NPK/ ha) than the plot treated with only recommended NPK. This increased grain yield with combined application of FYM and inorganic fertilizers might be due to better availability of nutrients at the root zone when compared to only recommend NPK applied plots. In the succeeding groundnut crop, the hand weeding twice recorded significantly higher pod yield (2,464 kg/ha), followed by pendimethalin at 1.0 kg/ha (2,326 kg/ha) and butachlor (2,264 kg/ha). Higher grain yields were recorded in the treatments which received 10 tonnes of FYM along with recommended dose of fertilizer (100 : 50 : 50 Kg NPK/ha) than the plot treated with only recommended NPK. The higher pod yield was reflected in terms of better growth and yield. Further, the growth and yield parameter showed significant relationship with pod yield indicating their positive effect on yield. Application of recommended dose of NPK and FYM treatment registered maximum net returns as compared to recommended dose of NPK alone in finger millet resulted in higher B ; C ratio. In the succeeding crop higher net return was recorded in NPK applied plot as compared to NPK + FYM applied plot.

Key words : Weed management, Fertility levels, Growth, Yield, Finger millet-groundnut cropping.

Groundnut (*Arachis hypogaea* L.) is grown on 24.61 m ha world wide with a total production of 36.72 m t and productivity level of 1,451 kg/ha. In India, groundnut is grown on 5.9 m ha with a productions of 8.18 mt and productivity of 1,366 kg/ha (1). The productivity of the groundnut is low in India as compared to other countries, untapped yield reservoir which could be exploited by adopting improved technologies. In India, finger millet is grown on an area of 1.6 m ha with a production of 2.1 mt and a productivity of 1,306 kg/ha. The productivity of groundnut and finger millet of the country is lower than that of world (2). The crops in their early stages of growth are more susceptible to weeds, hence elimination of weeds during early stages of crop growth would enable the plant to grow better and consequently yield better. Weed management is one important practice in the process of cultivation of field crops, weed varies with irrigated and rain fed situation and weed management technology is to be provided accordingly (3). Yadav et al. (4) reported that groundnut and finger millet need for initial weed free conditions of 15—45 days for better yield. The use of single method of weed control may not be effective under such climatic condition. Therefore, it is necessary to develop efficient weed management practice and fertility levels for sustainable crop production. Hence present investigation was carried out to assess the effect of different weed management practices and fertility levels in finger millet followed by groundnut.

Methods

An investigation was conducted at Hebbal, Uni-

Table 1. Effect of weed management practices and fertility levels on weed population, weed dry weight, growth, yield parameters and yield in finger millet during 2001 and 2002 (pooled). NS—Not Significant at 5% probability level, DAT—Days after transplanting, TDM—Total dry matter, Rec NPK—100 N : 50 P_2O_5 : 50 K_2O kg + FYM 7.5 t/ha. Data in parentheses are in transformed unit, log (x+2).

Treatments	Weed population (per m^2)	Weed Dry weight (g/m^2)	WCE	Leaf area (m^2)	TDM	Grain yield (kg/ha)	Straw yield (kg/ha)	Ear length (cm)	Ear dry weight/ plant (g)	1000 seed weight (g)	Grain weight/ plant (g)	Cost of weed control or fertilizers (Rs/ha)	B:C ratio (Rs/ Rs spent)
Weed Management Practices													
1 2, 4-D Na Salt at 0.75 kg ai/ha	17.7 (1.2)	20.6 (1.3)	79.3	814.3	19.8	3276	3953	5.8	11.2	2.82	8.1	400.0	2.04
2 Butachlor at 0.75 kg ai/ha	10.9 (1.0)	10.6 (1.0)	89.5	977.0	21.3	3393	3981	5.7	11.1	2.85	8.1	475.0	2.11
3 HW at 20 & 40 DAT	8.0 (0.8)	5.3 (0.7)	95.0	1082.0	24.1	3450	4105	5.7	11.4	2.86	8.6	1620.0	1.70
4 Unweeded control	65.1 (1.8)	105.2(2.0)		419.5	15.1	1944	2594	4.1	8.2	2.37	7.0	0.0	0.92
F test	*	*	–	*	*	*	*	*	*	*	*	–	–
SE ±	0.16	0.02	–	37.4	0.61	61	91	0.13	0.61	0.08	0.24	–	–
CD (*P*=0.05)	0.04	0.08	–	110.1	1.79	180	268	0.39	1.81	0.24	0.71	–	–
Fertility Levels													
1 Rec NPK + FYM	25.6 (1.2)	37.6 (1.3)	–	877.5	22.2	3086	3820	5.7	11.1	2.83	8.0	5822.1	0.39
2 Rec NPK alone	24.6 (1.2)	33.2 (1.2)	–	763.9	17.9	2946	3496	5.1	9.8	2.62	7.2	2447.1	0.75
F test	NS	*	–	*	*	*	*	*	*	*	*	–	–
SE ±	0.11	0.01	–	26.4	0.43	43	64	0.09	0.43	0.50	0.17	–	–
CD (*P*=0.05)	–	0.05	–	77.8	1.26	127	189	0.27	1.28	0.17	0.50	–	–

versity of Agricultural Sciences, Bangalore under irrigated condition during 2001 to 2003 on red sandy loam soil. The soil was low in organic carbon (0.34%), soil pH (6.0), available nitrogen (172.1 kg/ha), potassium (172.0 kg/ha) and medium in available phosphorus (31.3 kg/ha). The treatments in finger millet crop were butachlor at 0.75 kg ai/ha (pre-em, 3 DAT), 2,4-D Na salt at 0.75 kg/ha (post-em, 15 DAT), hand weeding twice (20 and 40 DAT) and unweeded control and two fertility levels, namely 100% recommended fertilizer (100 N, 50 P_2O_5 and 50 K_2O kg/ha) + FYM at 7.5 t/ha) and 100% recommended fertilizers alone. Finger millet variety HR-911 was sown at a common spacing of 22.5 cm × 10 cm with plot sizes of 4.5 m × 3.0 m (gross) and 3.6 m × 2.5 m (net plot). In the succeeding groundnut, treatments were pendimethalin and butachlor each at 1.0 kg ai/ha—3 DAS, hand weeding (20 and 40 DAS) and unweeded control along with two fertility levels (recommended fertilizers—25 kg N, 75 kg P_2O_5 and 37.5 kg K_2O/ha alone and with 10 t/ha FYM). These treatments were laid out in a factorial randomized complete block design with four replications in both the experiments. Groundnut variety TMV-2 was grown with a common spacing of 30 cm×15 cm. The observations on total weed and weed dry weight (per/m^2) were recorded at 30, 60, 90, 120 DAS/DAT and harvesting stages. The weed efficiency and weed index were worked out by using the formulae suggested by Mani et al. (5) and Gill and Vijay Kumar (6) respectively. Yield parameters were recorded at the time of harvesting by random sample and net return was worked out based on seed yield, input cost and total cost and marginal return was calculated based an cost of seed. Benefit cost ratio was worked out, taking into consideration of total cost the cultivation and net returns.

Table 2. Effect of weed management practices and fertility levels on weed population, weed dry weight, growth, yield parameters and yield in groundnut during 2002-2003 (pooled). NS—Not Significant at 5% probability level, DAS—Days after sowing, TDM—Total dry matter (60 DAS), WCE—Weed control efficiency, Rec NPK—25 N:75 P_2O_5 : 38 K_2O kg + FYM 10 t/ha, WI=Weed index (%).

		Weed population (m^2)	Weed dry weight (g/m^2	WCE	Leaf area (m^2) 60 DAS	TDM	Pod yield (kg/ha)	WI (%)
	Weed Management Practices							
1	Pendimethalin at 1.0 kg/ha	9.9 (1.0)	10.3 (1.0)	85.2	781.9	14.23	2326	5.6
2	Butachlor at 1.0 kg ai/ha	13.2 (1.1)	13.9 (1.1)	80.1	754.5	14.11	2264	8.0
3	HW at 20 & 40 DAS	6.8 (0.8)	6.6 (0.7)	90.8	909.7	17.42	2464	–
4	Unweeded control	45.8 (1.6)	64.6 (1.8)	–	606.0	10.24	1505	38.9
	F test	*	*		*	*	*	–
	SE ±	0.03	0.04		29.6	0.40	64.3	–
	CD (*P*=0.05)	0.09	0.12		87.11	1.18	189.3	–
	Fertility Levels							
1	Rec NPK + FYM	19.4 (1.1)	29.8 (1.2)		876.5	16.27	2474	–
2	Rec NPK alone	18.4 (1.1)	20.9 (1.1)		649.5	11.73	1806	–
	F test	NS	*		*	*	*	–
	SE ±	0.02	0.02		20.9	0.28	45.5	–
	CD (*P*=0.05)	–	0.08		61.5	0.84	133.8	–

Table 2. Continued.

		Pod weight per plant (g)	100 kernel weight (g)	Number of filled pods per plant	Per cent filled pods	Shelling (%)	Cost of weed control or fertilizers (Rs/ha)	B : C ratio (Rs/Rs spent)
	Weed Management Practices							
1	Pendimethalin at 1.0 kg/ha	36.8	29.1	28.6	74.1	69.9	1582.0	1.36
2	Butachlor at 1.0 kg ai/ha	35.4	28.1	26.4	68.0	70.0	550.0	1.51
3	HW at 20 & 40 DAS	38.4	28.9	26.5	70.1	70.7	1620.0	1.51
4	Unweeded control	23.4	23.7	15.7	47.6	64.5	0.0	0.75
	F test	*	*	*	–	*	–	–
	SE ±	1.2	0.67	1.01	–	0.70	–	–
	CD (*P*=0.05)	3.0	1.98	2.97	–	2.07	–	–
	Fertility Levels							
1	Rec NPK + FYM	36.1	29.2	29.8	70.5	70.1	6439.5	0.72
2	Rec NPK alone	31.0	25.6	21.8	60.3	67.4	1939.5	0.69
	F test	*	*	*	–	*	–	–
	SE ±	0.72	0.47	0.71	–	0.49	–	–
	CD (*P*=0.05)	2.12	1.40	2.10	–	1.46	–	–

Results and Discussion

Major Flora in Finger Millet Crop

Major weed flora observed in the experimental plots was *Cyperus rotundus* (a sedge); *Digitaria marginata* Link. *Dactyloctenium aegptium* Beauv., *Cynodon dactylon* Pers., *Chloris barbata* (from initial stage) and *Echinochloa colona* Link. (from 60 DAP) (among grasses). Among broad leaf weeds, major weeds were *Commelina benghalensis* L., *Lagascea mollis, Ageratum conyzoides* L., *Spilanthus acmella, Acanthospernium hispidium* (from initial stages), *Borreria articularis* and *Euphorbia hirta* (from 60 DAP). Other weeds observed in

Table 3. Relative economics of weed management in finger millet.

Treatments	Pod yield (kg/ha)	Yield difference over weed check	Marginal return (MR) (Rs/ha)	Marginal cost of weed management (MC) (Rs/ha)	MR/MC (Rs/Rs spent)
2, 4-D Na Salt at 0.75 kg ai/ha	3276	1332	7992	400	19.98
Butachlor at 0.75 kg ai/ha	3393	1449	8694	475	18.30
H W at 20 & 40 DAT	3450	1506	9036	1620	5.57
Unweeded control	1944	–	–	–	–

lower densities were *Panicum* sp. *Eragrostis pilosa* (among grasses), *Cleome monophylla, Amaranthus viridis, Emilia sanchyfolia, Phyllanthus niruri* and *Parthenium hysterophorus* (among broad leaf weeds). The studies conducted by Mahabaleshwara (7) and at Bangalore Center ((2) revealed similar weed flora in transplanted finger millet.

Major Flora in Groundnut Crop

The grassy weeds observed in the experimental plots were *Cynodon dactylon* Pers, *Digitaria marginata* Link., *Dactyloctenium aegyptium* Picht., *Chloris barbata* S. W., *Echinochloa colonum* Linn., *Setaria glauca* Linn., a sedge *Cyperus rotundas* Linn., whereas broad leaf weeds like *Ageratum conyzoides* Linn., *Commelina benghalensis* Linn., *Acantho spermum* hispidum Linn., were dominant. Similar weed flora was observed in earlier studies at Hebbal (2) and Sudhakar and Muniyappa (8).

In finger millet, hand weeding twice (20 and 40 DAT) (3,450 kg/ha) and butachlor at 0.75 kg ai/ha (3,393 kg/ha) and 2, 4-D Na salt at 0.75 kg ai/ha (3,276 kg/ha) recorded significantly higher grain yield as compared to unweeded control treatment (1,944 kg/ha). The increase in grain yield was due to increased yield components viz. ear length and grain weight per plant. This was further substantiated by number of ears per hill, ear length and grain weight per plant. Weed competition as observed in unweeded control lowered the grain yield by 43.5%, as also revealed by higher weed index. This effective control of weeds resulted in more availability of nutrients, moisture, space and light for the development of more number of ears per hill, ear length and grain weight per plant of finger millet during both the years. These conditions favored for better development of grain as a result of better translocation of photosynthates from source to the sink. In the present study, higher yield showed better relationship with growth characters indicating mutual inter dependence as also observed by Ramachandra Prasad (9).

Application of recommended NPK + FYM gave higher grain yield (3,086 kg/ha) which was found to be 9.5% higher than recommended dose of NPK alone (2,946 kg/ha). This might be due to release of both NH_4-N and NH_3 N steadily during active crop growth period and in turn might have favored the crop for obtaining higher yield, as also revealed by Mani (10). Higher grain weight per plant by 9% is observed in recommended NPK + FYM treatment compared to recommended NPK alone. This might have acted as a higher sink for development of more grains leading to higher yield. Similar results were also recorded by Radhakrishna (11). The application of recommended NPK (100 : 50 : 50 kg/ha) + (7.5 t) of FYM/ha treatment significantly increased the ear length, ear weight per plant and 1,000-grain weight by 5.7 cm, 11.1 g and 2.8 g, respectively. Combined application of FYM and inorganic fertilizer could have created a favorable physical environment for the increased available N resulting in mineralization, mobility of nutrients and as noticed by improvement in uptake of nutrients (12).

In the succeeding crop of groundnut pod yield was highest in pendimethalin (pre-em) at 1.0 kg ai/ha (2,326 kg/ha) and butachlor at 1.0 kg ai/ha (per-em) (2,264 kg/ha). These were comparable with hand weeding twice (2,464 kg/ha). The lowest was observed in unweeded control (1,504 kg/ha). The per cent increases in the pod yield with pendimethalin 1.0 kg ai/ha and butachlor (pre-em) 1.0 kg ai/ha were 64 and 66% over unweeded control. The increased yield in plots receiving pendimethalin and butachlor was due to favorable condition provided by the herbicides to the crop from early stages by controlling weeds efficiently. Such conditions must have led to better utilization of soil moisture, nutrient uptake by crop and favourable conditions for development of gynopores. All these might have resulted in better photosynthe-

Table 4. Relative economics of weed management in groundnut.

Treatments	Pod yield (kg/ha)	Yield difference over weed check	Marginal return (MR) (Rs/ha)	Marginal cost of weed management (MC) (Rs/ha)	MR/MC (Rs/Rs spent)
Pendimethalin at 1.0 kg/ha	2326	821	9852	1582	6.22
Butachlor at 1.0 kg ai/ha	2264	759	9108	550	16.56
H W at 20 & 40 DAS	2464	959	11508	1620	7.10
Unweeded control	1505	–	–	–	–

sis and distribution of photosynthates to the economic part, as evident from higher leaf and higher dry matter distribution into pods. Further, higher values of yield components such as number of filled pods per plant and pod weight per plant caused higher pod yield in groundnut. Similar results were also reported by Madhakar et al. (13).

Application of recommended NPK and FYM treated plots recorded significantly higher pod yield (2,474 kg/ha) as compared to recommended NPK alone treated plots (1,805 and 2,458 kg/ha, respectively). This increase in pod yield may be due to higher magnitude of yield components viz. 100 kernel weight, pod weight per plant, number of filled pods/plant, and per cent filled pods. Improvement in yield parameters and yield may be due to adequate supply of nutrients coupled with improvement in physico-chemical properties in treatments with application of 25 : 75 : 37.5 Kg N, P_2O_5 and K_2O + 10 t FYM/ha. An adequate supply of plant nutrients is necessary for enhanced metabolic activity, which in turn influence the plant growth. High and sustained crop yield could be obtained with judicious and balanced NPK fertilizers combined with organic amendments. Organic manures in conjunction with chemical fertilizers particularly those of N, appeared to counteract the negative effects of fertilizers like acidification and depletion of nutrients supply through the fertilizers (14).

Use of 2, 4-D N salt and butachlor for weed management was able to save Rs 1,220 and 1,145/ha over traditional farmer's method of two hand weeding (Rs 1,620/ha) in finger millet. This suggested that herbicides are economical and cost effective in managing weeds during initial stages as compared to hand weeding. Similarly results were also observed earlier (2, 9). Use of butachlor and 2, 4-D Na salt gave additional net returns of Rs 869 and 239/ha, respectively over hand weeding. Similarly use of pendimethalin and butachlor in groundnut was able to save weeding cost to an extent of Rs 98 and 1,070 per ha over traditional farmers method of two hand weeding (Rs 1,620/ha). This evidently indicated that use of herbicides prevented weed emergence from initial stages and consequently increased the yield over hand weeding. This increased yield provided higher monetary returns. Similarly when compared to unweeded control, considering the gross returns and cost of weed management practices, the benefit accrued due to weed management was considerably higher as also reported by Jen and Tripathy (15).

Application of recommended NPK and FYM recorded higher net returns as compared to recommended NPK alone in finger millet and groundnut. This was mainly due to higher grain, pod, and straw yield. Whereas B : C ratio was relatively higher in recommended NPK alone treatment as a result of less cost on nutrients, as compared to recommended NPK and FYM treatment. These results are in conformation with the findings of Udayansoorian et al. (16). This suggested that herbicides are economical and cost effective in managing weeds right from the initial stages as compared to hand weeding, as also observed earlier (2, 17). Similarly marginal cost was quite low in herbicide treated plots as compared to hand weeding.

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