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RESEARCH PAPER

Effect weed management practices and fertility levels on soil health in finger millet–groundnut cropping system

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Abstract : The application of herbicide like butachlor and 2, 4- D Na salt each at 0.75 kg ai/ha in finger millet and, butachlor and pendimethalin each at 1.0 kg ai/ha in the succeeding groudnut showed higher microbial biomass in the soil at harvest as compared to hand weeding or unweeded control. Usage of butachlor and 2,4-D Na salt in finger millet and butachlor 0.75 to 1.0 kg ai/ha and pendimelnalin 1.0 kg ai/ha in groundnut helped in retaining higher N, P_2O_5 and K_2O nutrient status in soil, as compared to hand weeding and unweeded control. Owing to better control of weeds in the cropping system of finger millet - groundnut, application of FYM along with recommended fertilizer recorded significantly higher available nitrogen, phosphorus and potassium in the soil as compared to mere application of recommended NPK alone. Application of recommended NPK + FYM treatment maintained neutral pH, where as only recommended NPK alone treatment caused reduction of soil pH (acidic).

Key Words : Weed management practices, Finger millet, Groundnut, Fertility levels

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INTRODUCTION

Groundnut (*Arachis hypogaea* L.) an important oilseed and leguminous crop,is gaining popularity among the farmers of Eastern dry zone of Karnataka. Similarly, finger millet [*Eleusine coracana* (L.) Gaertn.] is one of the important cereal crop of Southern Karnataka, as it is staple food crop. The production and productivity of these crops is lower due to infestation of weeds, which is a major constraint in their production. Owing to initial slow growth of the crops, weeds dominate and become a major factor in lowering the productivity as a result of more competition for sunlight, nutrients and moisture. Nanjappa and Balakrishna (1989) noticed that application of herbicides such as 2, 4 D, neburon, propanil and nitrofen at 0.5 to 1.0 kg/ha showed depressive effect on the soil microbial population during first 30 days of herbicide application and there after buildup of population of soil bacteria, fungal, actinomycetes and *Azotobacter* to the original level was observed in finger millet crop at Hebbal, Bangalore. Similarly, Yadav and Tiwari (1993) revealed that continuous soil application of herbicides (fluchloralin and oxadiazon at 1.0 kg/ha, oxyfluorfen 0.1 kg per ha and butachlor at 2.0 kg/ha) for four years did not affect the population of soil fauna (Black cricket, green leaf hopper, small red ant, small blank ant, spider and ground beetle) in soybean – wheat cropping system. In a herbicide experiment conducted at Hebbal, Bangalore, in finger millet – groundnut cropping system, application of herbicides such as metolachlor, pendimethalin along with 10 tonnes of FYM per ha improved soil pH ,organic carbon, EC and B.D remained constant in finger millet - groundnut system (Anonymous, 2002). Similarly on microbial growth, application of metolachlor 1.0 kg a.i. ha^{-1} with or without FYM in groundnut and butachlor 0.75 kg ai/ha in finger millet at recommended fertilizer dose recorded higher total microbial weight (Anonymous, 2002).Thus, these indicated that many of herbicides recommended for weed management in crops appeared to have initial slight suppression on microbial growth. Subsequently the microbial growth picked up and compared equal to that of untreated

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plots. It is inevitable to have integrated nutrient supply system through combined use of organic and chemical source of plant nutrients for long term sustainability in crop production. Further, application of organic can counter act the deleterious effect of continuous use of fertilizers on physical, chemical and biological properties of soil. Therefore, the present study was undertaken to find out the effect of weed management practices along with fertility levels (organic and inorganic) on available nutrients status of soil at harvest of finger millet - groundnut cropping system.

MATERIAL AND METHODS

An agronomic investigation was conducted at Hebbal, University 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) and potassium (172.0 kg/ha) and medium in available phosphorus (31.3 kg/ha). The treatments in finger millet crop were butachlor 0.75 kg ai/ ha (pre-em., 3 DAT), 2,4-D Na salt 0.75 kg/ha (post - em., 15 DAT), hand weeding twice (20 and 40 DAT) and unweeded control and two fertility levels namely 100 per cent recommended fertilizer (100 N, 50 P_2O_5 and 50 K_2O k/ha) + FYM at 7.5 t / ha)and 100 per cent recommended fertilizers alone. Finger millet variety HR-911 was sown at a common spacing of 22.5cm x 10cm with plot sizes of 4.5m x 3.0m (gross) and 3.6m x 2.5m (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 fertilizer alone – 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 RCBD with four replications in both the experiments. After the harvest of each crop, samples were collected from each plot separately. Samples were collected randomly in 0-15 cm top soil pooled in each plot. Then soil was dried, passed through 2 mm sieve. The sieved soil was used for estimation of physical, chemical and biological parameters *viz*., soil reaction (pH) (Piper, 1966), electrical conductivity (Jackson, 1973), organic carbon (Jackson, 1973), available nitrogen (Jackson, 1973), available phosphorus (Jackson, 1973), available potassium (Jackson, 1973) and microbial biomass(by fumigation and extraction method as proposed by Carter (1991) in each treatments.

RESULTS AND DISCUSSION

Results are presented in Table 1, 2 and 3.

Soil biological activity:

The continous use of herbicides like butachlor and 2, 4- D Na salt each 0.75 kg/ha in finger millet crop and butachlor and pendimethalin each at 1.0 kg/ha in groundnut crop showed higher microbial biomass at the harvest as compared to unweeded control and hand weeding. This higher microbial biomass in herbicide treated plots was mainly due to degradation of herbicides and usage of herbicides as substrate by the microbes. This perhaps paved way for build up of population of soil bacteria, fungi, actinomycetes and *Azotobacter* as a result of application of herbicide, as also indicated in finger millet (Nanjappa and Balakrishna, 1989) and groundnut (Anonymous, 2002). Application of FYM along with fertilizer imporved the microbial biomass significantly as compared to mere application of fertilizer alone in both the years and cropping systems, owing to increase in organic carbon content which paved way for build up of microbes for the degradation process as revelaed by Kavalappa (1989).

Soil health:

Usage of butachlor and 2, 4-D Na salt each at 0.75 kg/ ha in finger millet during 2001-02; and butachlor and pendimelnalin each at 1.0 kg/ha in groundnut during 2002-03 helped in retaining higher contents of N, P_2O_5 and K_2O in the soil as compared to hand weeding and unweeded control. This was mainly due to better control of weeds right from the initial stages due to application of herbicides which prevented mining of nutrients by the weeds. These results are in confirmation with earlier studies conducted at Hebbal (Anonymous, 2002). Application of herbicides butachlor, pendimethalin and 2, 4-D Na salt, did not affect the electrical conductivity and organic carbon considerably and no proper trend was observed due to herbicide application. These results are confirmation with the earlier studies conducted at Hebbal (Anonymous, 2002). Thus herbicides application in the cropping system of finger milelt - groundnut did not affect the soil health. Further, application of herbicides particularly butachlor application in both the cropping systems slightly increased the soil pH in the second season of the system, as compared to hand weeding and unweeded control.

Application of FYM along with fertilizer resulted in higher available nitrogen in the soil as compared to recommended NPK alone in both the crops in finger millet and groundnut. As observed in the present investigation, Black (1993) reported higher available N content in the soil due to organic matter, as N content has a direct relationship with organic matter content. The combined application of FYM along with fertilizer might have contributed for greater multiplication of soil microbes which perhaps caused conversion of organically bound N to inorganic form, as observed by Gajanana *et al.* (2000) and Parasuraman *et al.* (2000).

In both the crops finger millet and groundnut, application of FYM along with fertilizer recorded

Table 1: Effect of weed management practices and fertility levels on soil health in finger millet 2001-,2002 (Pooled data)

Treatments	M.B (μ g g^{-1} of soil)			EC (dSm^{-1})			Organic carbon (%)			N (Kg/ha)			P_2O_5 (kg/ha)			K_2O(kg/ha)		
	2001	2002	Mean	2001	2002	Mean	2001	2002	Mean	2001	2002	Mean	2001	2002	Mean	2001	2002	Mean
Weed management practices																		
1. 2, 4-D Na Salt at 0.75 kg ai ha^{-1}	526.8	552.7	540.0	0.25	0.29	0.27	0.38	0.48	0.43	173.1	188.8	181.0	46.7	58.5	52.6	181.0	192.3	186.6
2. Butachlor at 0.75 kg ai ha^{-1}	565.1	491.5	528.3	0.25	0.30	0.25	0.39	0.47	0.43	172.9	185.2	179.0	45.5	56.7	51.1	180.6	190.8	185.7
3. H.W at 20 and 40 DAT	244.0	198.8	221.4	0.24	0.30	0.27	0.40	0.49	0.44	168.8	177.2	173.0	42.3	53.0	47.6	178.4	186.6	182.5
4. Unweeded control	215.5	185.5	200.5	0.25	0.30	0.27	0.38	0.49	0.43	168.8	176.1	172.4	42.9	52.8	47.8	178.0	184.6	181.3
Mean	387.9	357.2	372.5	0.25	0.30	0.25	0.39	0.48	0.43	170.9	181.3	176.1	44.3	55.2	49.7	179.5	188.5	184.0
Initial value	230.0			0.22			0.34			172.4			31.3			172.0		
F test	*	*		NS	*		*	*		*	*		*	*		*	*	
S.E.±	13.7	4.17		0.02	0.003		0.005	0.005		0.69	1.56		0.23	0.28		0.38	0.29	
C.D. (P=0.05)	33.1	10.11		-	0.006		0.013	0.012		1.67	3.78		0.57	0.68		0.92	0.70	
Fertility levels																		
1. Rec. NPK - 100 N:50 P_2O_5 :50 K_2O kg + FYM 7.5 t/ha	467.6	420.6	444.1	0.19	0.17	0.18	0.43	0.56	0.49	183.7	197.3	190.5	52.5	67.5	60.0	181.2	196.5	188.8
2. Rec. NPK - 100 N:50 P_2O_5 :50 K_2O kg + FYM 7.5 t/ha	308.0	493.8	400.9	0.30	0.42	0.36	0.34	0.41	0.37	158.2	165.3	161.7	36.2	43.0	39.6	177.8	180.6	179.2
Mean	387.9	357.2	372.5	0.25	0.30	0.27	0.39	0.48	0.43	170.9	181.3	176.1	44.3	55.2	49.7	179.5	188.5	184.0
Initial value	230.0			0.22			0.34			172.4			31.3			172.0		
F test	*	*		*	*		*	*		*	*		*	*		*	*	
S.E.±	9.6	2.95		0.02	0.002		0.003	0.003		0.48	1.10		0.16	0.20		0.29	0.20	
C.D. (P=0.05)	23.4	7.14		0.004	0.005		0.009	0.009		1.18	2.67		0.40	0.49		0.65	0.50	
Interaction F test	*	NS		*	*		*	0.48		*	*		*	*		*		

Note : NS - Not Significant * indicates significance of value at P 0.05 M.B-Microbial Biomass EC-Electrical conductivity

Table 2 : Effect of weed management practices and fertility levels on soil health in groundnut 2002, 2003 (Pooled data)

Sr. No.	Treatments	M.B (μ g g^{-1} of soil)			EC (dSm^{-1})			Organic carbon (%)			N (Kg/ha)			P_2O_5 (Kg/ha)			K_2O(Kg/ha)		
		2002	2003	Mean	2002	2003	Mean	2002	2003	Mean	2002	2003	Mean	2002	2003	Mean	2002	2003	Mean
Weed management practices																			
1.	Pendimethalin at 1.0 kg ha^{-1}	481.6	568.7	525.1	0.29	0.29	0.29	0.39	0.56	0.47	179.4	193.4	186.4	53.2	64.1	58.6	187.2	199.9	193.5
2.	Butachlor at 1.0 kg ai ha^{-1}	445.9	548.9	497.4	0.28	0.30	0.29	0.41	0.56	0.48	179.1	191.5	185.3	52.6	63.9	58.2	185.9	196.3	191.1
3.	H.W at 20 and 40 DAS	189.1	239.8	214.4	0.27	0.30	0.28	0.40	0.56	0.48	175.0	192.5	183.7	50.0	60.0	55.0	183.8	189.2	186.5
4.	Unweeded control	188.6	192.6	190.6	0.27	0.30	0.28	0.38	0.57	0.47	170.0	188.1	179.0	47.6	58.8	53.2	180.1	186.5	183.3
	Mean	326.2	386.8	356.5	0.27	0.30	0.28	0.40	0.56	0.48	175.9	191.4	183.6	50.8	61.7	56.2	184.2	193.0	188.6
	Initial value	230.0			0.22			0.34				172.4			31.3			172.0	
	F test	*	*		*	*		*	NS		*	*		*	*		*	*	
	S.E.±	10.7	1.81		0.003	0.002		0.004	0.005		0.83	0.69		0.30	0.23		0.64	0.38	
	C.D. (P=0.05)	26.0	4.39		0.008	0.004		0.10	-		2.00	1.67		0.74	0.57		1.56	0.92	
Fertility levels																			
1	Rec. NPK - 25 N:75 P_2O_5 :38 K_2O kg + FYM 7.5 t/ha	377.8	470.1	423.9	0.18	0.16	0.17	0.45	0.62	0.53	188.6	206.4	197.5	62.0	78.9	70.4	189.1	202.7	195.9
2	Rec. NPK - 25 N:75 P_2O_5 :38 K_2O kg + FYM 7.5 t/ha	274.7	303.0	288.8	0.36	0.45	0.40	0.35	0.54	0.44	163.2	176.3	163.21 69.7	39.7	44.5	42.1	179.3	183.0	181.1
	Mean	326.2	386.8	356.5	0.27	0.30		0.40	0.56	0.48	175.9	191.4	183.6	50.8	61.7	56.2	184.2	193.0	188.6
	Initial value		230.0		0.22			0.34				172.4			31.3			172.0	
	F test	*	*		*	*		*	*		*	*		*	*		*	*	
	S.E.±	7.6	1.28		0.002	0.002		0.003	0.003		0.58	0.48		0.21	0.16		0.45	0.29	
	C.D. (P=0.05)	18.4	3.11		0.006	0.004		0.007	0.008		1.42	1.18		0.52	0.40		2.20	0.65	
	Interaction F test	*	*		*	*		*	*		*	*		*	*		*	*	

Note : NS=Non-significant * indicates significance of value at P=0.05 M.B-Microbial Biomass, EC-Electrical conductivity

Table 3 : Effect of weed management practices and fertility levels on pH in finger millet-groundnut

Sr. No.	Treatments (Groundnut)	pH			Treatments(Finger millet)			
		2001	2002	Mean		2002	2003	Mean
Weed management practices					**Weed management practices**			
1.	Pendimethalin at 1.0 kg ha^{-1}	6.14	6.25	6.19	2, 4-D Na Salt at 0.75 kg ai ha^{-1}	6.10	6.09	6.09
2.	Butachlor at 1.0 kg ai ha^{-1}	6.14	6.27	6.20	Butachlor at 0.75 kg ai ha^{-1}	6.10	6.16	6.13
3.	H.W at 20 and 40 DAS	6.10	6.03	6.06	H.W at 20 & 40 DAT	6.10	6.03	6.06
4.	Unweeded control	6.10	6.08	6.09	Unweeded control	6.10	6.02	6.06
	Mean	6.12	6.16	6.14	Mean	6.10	6.08	6.09
	Initial value	6.0			Initial value	6.00		
	F test	*	*		F test	NS	*	
	S.E.±	0.10	0.019		S.E.±	0.017	0.033	
	C.D. (P=0.05)	0.02	0.047		C.D. (P=0.05)	-	0.080	
Fertility levels					**Fertility levels**			
1.	Rec. NPK - 27 N:75 P_2O_5 :38 K_2O kg + FYM 7.5 t/ha	6.48	6.65	6.56	Rec. NPK - 100 N:50 P_2O_5 :50 K_2O kg + FYM 7.5 t/ha	6.27	6.35	6.31
2.	Rec. NPK - 25 N:75 P_2O_5 :38 K_2O kg + FYM 7.5 t/ha	5.75	5.67	5.71	Rec. NPK - 100 N:50 P_2O_5 :50 K_2O kg + FYM 7.5 t/ha	5.92	5.81	5.86
	Mean	6.12	6.16	6.14	Mean	6.10	6.08	6.09
	Initial value	6.00			Initial value	6.00		
	F test	*	*		F test	*	*	
	S.E.±	0.007	0.014		S.Em±	0.012	0.023	
	C.D. (P=0.05)	0.017	0.033		CD (p=0.05)	0.03	0.056	
	F test(Interaction)	*	*			*	*	

Note : NS=Non-significant * indicates significance of value at P=0.05

significantly higher phosphorus in the soil over the recommended NPK alone. The reasons for this could be attributed to the dissolution of native P compounds by decomposition products of FYM. Besides, FYM itself perhaps contributed for this available pool upon mineralization, as it contained 2 per cent organic form of phosphorus and as indicated by Chaudhary *et al.* (1981). Besides, K_2O content in the soil was significantly improved with application of FYM along with fertilizer as compared to recommended NPK alone. This was obviously due to the direct use of K fertilizer and the contribution to the available K pool from the FYM. FYM has been reported to have a direct and ready source of K and also help in minimizing the leaching loss of K by retaining K ions on exchange site, as observed by Bansal (1992).

Application of recommended NPK + FYM (7.5 t ha^{-1}) in finger millet and NPK + FYM (10 t ha^{-1}) in groundnut resulted in reduction of electrical conductivity from 0.22 to 0.16 dsm^{-1}. This was mainly due to application of FYM, which reduced the preferential adsorption of divalent cation (Ca^{++}, Na^{++}) by organic matter. These results are in confirmation with findings of Gajanan *et al.* (2000). Application recommended NPK + FYM treatment maintained neutral pH status, where as only recommended NPK alone treatment caused reduction of soil pH (acidic). This was mainly due to application of FYM which helped in buildup of soil microbial population and increased production of organic acids. These organic acids dissolved most salts and maintained pH at neutral. These results are in confirmation with the findings of Gajanna *et al.* (2000).Thus use of herbicides butachlor and 2,4-DEE in finger millet and butachlor and pendimethalin in groundnut did not affect the soil micro flora and physical –chemical properties in cropping system during 2001-2003

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