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Crop Weed Competition for Nutrients By Weeds and Drill Sown Finger Millet [*Eleusine Coracana* (L.) Gaertn.]

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Abstract: *A field experiment was carried out on red sandy loam soils of Zonal Agricultural Research Station , V. C. Farm Mandya, Karnataka during late kharif, 2013 to investigate the effect of chemical weed management practices on nutrient uptake by weeds and drill sown finger millet. The results revealed that pre-emergence application of Bensulfuron methyl (0.6% G) + Pretilachlor (6.0 % G) @ 10 kg ha^{-1} recorded significantly lower weed population (20.33 per 0.25 m^2), weed dry weight (7.56 g per 0.25 m^2) and nutrient uptake by weeds (8.2, 3.3 and 6.3 kg NPK ha^{-1}, respectively) as compared to unweeded check (172.33 no. per m^2, 58.44 g per m^2 and, 49.1, 14.0, 32.7 kg NPK ha^{-1}, respectively). However, pre-emergence application of Bensulfuron methyl (0.6% G) + Pretilachlor (6.0 % G) at 7.5 kg ha^{-1} recorded significantly higher grain and straw yield (3291 and 5208 kg ha^{-1}, respectively) and nutrient uptake (72.5, 16.1 and 56.7 kg NPK ha^{-1}, respectively) by drill sown ragi. Whereas, the net returns (Rs.42338 ha^{-1}) was higher with the pre-emergence application of bensulfuron methyl (0.6 % G) + pretilachlor (6.0 % GR) at 7.5 kg ha^{-1} as compared to unweeded check (Rs.-2602 ha^{-1}). From the studies it can be concluded that pre-emergence application of Bensulfuron methyl (0.6% G) + Pretilachlor (6.0 % G) @ 10 kg ha^{-1} reduced the weed competition for nutrients as a result of this the grain yield and nutrient uptake by crop was more.*

Keywords: *Nutrient uptake, crop weed competition, correlation studies*

INTRODUCTION

Finger millet (*Eleusine coracana* (L.) *Gaertn*.) is an important food crop of Karnataka which locally known as Ragi. In Karnataka, finger millet is grown in an area of 7.88 lakh ha, production of 12.72 lakh tonnes and with productivity of 1871 kg ha^{-1} in the state as coated by Anonymous (2013). Finger millet is grown largely as drill sown crop under rainfed condition. The crop has slow growth habit in the initial stages. Therefore, the major constraint to get higher yield in drilled sown ragi is weed infestation which cause around 80-100% reduction in grain yield. Weeds that grow with the crop deplete considerable amount of plant nutrients, which results in lower crop yields. Nutrient depletion by weeds, besides other factors, depends on soil type and composition of weeds. Management of weeds in drilled sown ragi is a very difficult task. In order to check the losses caused by weeds it is vital to control all types of weeds during crop growth period to enhance growth and yield. With this context, the experiment entitled the effect of chemical weed management practices on nutrient uptake by weeds and drill sown finger millet under rainfed conditions was formulated.

MATERIALS AND METHODS

Study area

A field experiment was conducted at Zonal Agricultural Research Station, V. C. Farm, Mandya during late *Kharif*, 2013. The composite surface (0-20 cm) soil samples were collected from the experimental plot was analyzed for different basic soil properties by adopting standard laboratory procedure as coated by Keram *et al.* (2014). The soil texture of the experimental site was red sandy loam with a neutral pH (6.91) and was medium in organic carbon content (0.61%). The available nitrogen, phosphorus and potassium status in soil was medium.

Experimental Setup

Treatments Details

The experiment was setup in a randomized block design with three replications consisting of 12

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treatments *viz*., **T1:** Butachlor (50 EC) at 0.75 kg a.i./ ha as pre-emergence spray, **T2**: Butachlor (50 EC) at 1.00 kg a.i./ha as pre-emergence spray, **T3**: Oxyfluorfen (23.5 EC) at 66 g a.i./ha as pre-emergence spray, **T4**: Oxyfluorfen (23.5 EC) at 88 g a.i./ha as pre-emergence spray, **T5**: Oxadiargyl (80 WP) at 60 g a.i./ ha as pre-emergence spray, **T6**: Oxadiargyl 80 (WP) at 80 g a.i./ ha as pre-emergence spray, **T7**: Bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) at 7.5 kg/ha (pre mix formulation) as pre-emergence application , **T8**: Bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) at 10 kg/ha (pre mix formulation) as pre-emergence application, **T9**: Bispyribac sodium (10% SC) 15 g a.i./ha at 15 DAS, **T10**: Bispyribac sodium(10% SC) 20 g a.i. /ha at 15 DAS, **T11**: Two hand weeding at 20 & 40 DAS, **T12**: Unweeded check. One common intercultivation was given at 35 days after sowing from T1 to T10 in order to create root aeration required for better growth and development of crops as reported by Sunil and Shankaralingappa (2014a). The variety used was Indaf-7. This variety was developed from V.C. Farm, Mandya, University of Agricultural Sciences, Bangalore. It is suitable for winter season. The variety is having medium plant height, ear head is semi compacted cox comb type and comes to maturity in 115 to 120 days. Variety is having moderate resistance to pest and diseases. It is having higher grain yield potential of 5 to 6 t ha^{-1}. Sowing was done using seed drill in a row of 30 cm apart to a depth of 2.5 cm. Equal quantity of farm yard manure at the rate of 7.5 t ha^{-1} was applied to each plot three weeks prior to sowing. A basal dose of nitrogen (50 kg/ha) and complete quantity of P and K (40:25 kg/ha) were applied at the base of seed row and covered with soil and remaining quantity of nitrogen 25 kg of nitrogen was applied in two equal splits each at 30 DAS and 45 DAS in the form of urea. Pre-emergence application of herbicides was done at three days after sowing. Since the data on weed count and weed dry weight showed high variation, the data were subjected to square root transformation using formula Öx+0.5 and statistical analysis was done.

Finger millet grains, straw and weed samples were collected from experimental plots at harvest were oven dried and grounded into fine powder using Wiley mill were analyzed for nutrient uptake (N, P and K, respectively). Nitrogen, phosphorus and potassium content of the samples were estimated by MicroKjeldhal method, Vanadomolybdo phosphoric yellow colour method and flame photometer method, respectively and subsequently the uptake per hectare was computed both in weeds, grain and straw as procedure coated by Sharma *et al*. (2013). The procedure followed by Sunil *et al*. (2011) was adopted to work out the economics of different weed control treatments information on the existing market price of different herbicides and inputs was used. Labour units required for hand weeding and herbicide application was considered in addition to regular components of the cost of cultivation. Cost of labour was calculated by taking into account the prevailing labour wages at the time of investigation. Gross returns and net returns were worked out by using the following formulae and expressed in rupees per hectare.

Gross return = [Grain yield x market rate of grain] + [straw yield x market rate of straw].

Net returns = Gross returns – total cost of cultivation

The data collected were subjected to statistical analyses in the randomized complete block design following the method of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Effects on weed

The predominant weed flora observed in the experimental field in association with the drill sown finger millet were grasses *viz*, *Eleusine indica* (L.) Gaertn., *Chloris barbata Sw., Cynodon dactylon (L.) P and Dactyloctenium aegyptium*. Among broad leaved weeds *Commelina benghalensis, Ageratum conyzoides, Croton bonplandianum, Celosia argentia, Ocimum canum, Euphorbia hirta, Leucas aspera* and *Physalis minima L.* and among sedges *Cyperus rotundus* as reported by Madhu kumar *et al*. (2013) and Sunil and Shankaralingappa (2014b).

Pre-emrgence application of Bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) at 10 kg ha^{-1} (pre mix formulation) recorded significantly lower total weed population and total weed dry weight, respectively and was being on par with pre-emrgence application of Bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) at 7.5 kg ha^{-1} (pre mix formulation). Whereas, unweeded check recorded significantly higher weed population and weed dry weight, respectively (Table 1). The reduction in the weed population and weed dry weight in these treatments was mainly due to effective control of weeds at all stages of crop growth period. These results are in conformity with the findings of Sanjoy Saha (2005) and Madhu Kumar *et al*. (2013).

Nutrient uptake by weeds

Unweeded check recorded maximum uptake of nutrients by weeds. This was mainly due to no control

of weeds which has facilitated the weeds to utilize nutrients to maximum extent. Similarly increase in nutrient uptake by increase in weed competition also reported by Madhu Kumar *et al*. (2013), Rana *et al*. (2002) and Sunil *et al*. (2011). However, pre-emergence application of Bensulfuron methyl (0.6% G) + Pretilachlor (6.0% G) at 10 kg ha^{-1} recorded significantly lower Nutrient uptake by weeds and was being on par with Bensulfuron methyl (0.6% G) + Pretilachlor (6.0% G) at 7.5 kg ha^{-1} (Table 1).

Effect on yield and nutrient uptake by finger millet

Among different weed management practices, pre-emrgence application of Bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) at 7.5 kg ha^{-1} (pre mix formulation) recorded significantly higher grain yield and straw yield as compared to unweeded check and which was on par with two hand weedings at 20 and 40 DAS. Similar trend was observed with NPK uptake by grain and straw of drill sown ragi as compared to unweeded check and this was on par with two hand weedings at 20 and 40 DAS (Table 2). Higher nutrient uptake was due to lesser phytotoxicity, lower weed population and lower weeds dry weight which helped the crop to grow well and absorbed more nutrient from the soil. These results were in line with Madhu Kumar *et al*. (2013) and Sunil *et al*. (2011).

Effect on economics

Maximum gross returns and net returns were obtained with pre-emergence application of bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) at 7.5 kg ha^{-1} (pre mix formulation). The higher net returns and gross returns in these two treatments were due to higher grain yield and straw yield (Table 3).

Table 1
Effect of weed management practices on weed parameters and nutrient uptake by weeds

S.I. No.	*Weed population (No./0.25m²)*	*Weed dry weight (g/0.25m²)*	*Nutrient uptake by weeds (kg ha⁻¹)*		
			N	*P*	*K*
T_1	6.23 (38.33)	4.51 (19.97)	16.0	8.8	13.2
T_2	5.61 (31.00)	3.71 (13.27)	13.3	6.4	10.1
T_3	6.38 (40.33)	4.98 (24.33)	23.4	10.7	19.5
T_4	6.04 (36.00)	4.54 (20.15)	17.7	9.3	14.5
T_5	6.25 (38.67)	5.31 (27.79)	27.8	12.2	24.5
T_6	6.05 (36.33)	5.04 (24.96)	24.0	11.0	20.0
T_7	4.77 (22.33)	3.05 (8.90)	9.3	4.3	7.8
T_8	4.56 (20.33)	2.82 (7.56)	8.2	3.3	6.3
T_9	7.44 (55.00)	6.07 (36.53)	35.1	13.2	27.8
T_{10}	7.15 (50.67)	5.83 (33.50)	32.2	12.8	24.1
T_{11}	5.01 (24.67)	3.24 (10.15)	10.6	4.5	8.9
T_{12}	13.15 (172.33)	7.67 (58.44)	49.1	14.0	32.7
S.Em ±	0.12	0.11	1.14	0.45	0.91
CD(P=0.05)	0.37	0.35	3.36	1.33	2.69

Note: Values in parenthesis are original values

Table 2
Effect of weed management practices on grain and straw yield, and nutrient uptake by crop at harvest

S.I. No.	*Grain yield (kg ha⁻¹)*	*Straw yield (kg ha⁻¹)*	*Nutrient uptake by weeds (kg ha⁻¹)*								
			N			*P*			*K*		
			Grain	*Straw*	*Total*	*Grain*	*Straw*	*Total*	*Grain*	*Straw*	*Total*
T_1	2467	4009	33.8	16.5	50.3	6.7	4.0	10.7	11.1	29.2	40.3
T_2	2598	4119	36.1	17.9	54.0	7.3	4.6	11.9	11.9	30.1	42.0
T_3	2052	3521	27.1	13.2	40.3	5.4	3.5	8.8	8.8	22.9	31.7
T_4	1872	3274	24.3	12.2	36.5	4.9	3.1	7.9	7.8	20.6	28.4
T_5	2268	3753	30.8	15.1	46.0	6.1	3.9	10.1	10.2	26.6	36.8
T_6	2188	3635	29.3	14.0	43.3	5.7	3.7	9.4	9.4	24.8	34.2
T_7	3291	5208	47.3	25.1	72.5	9.2	7.0	16.1	16.1	40.6	56.7
T_8	2797	4301	38.9	19.5	58.4	7.9	4.9	12.8	12.8	32.2	45.1
T_9	1807	3145	23.7	11.3	35.1	4.5	2.9	7.4	7.4	19.8	27.2
T_{10}	1640	2814	21.4	10.2	31.6	3.9	2.6	6.6	6.5	17.1	23.7
T_{11}	2997	4519	43.8	21.8	65.7	8.7	6.6	15.3	14.6	35.6	50.3
T_{12}	814	1373	13.1	8.3	21.4	3.1	2.2	5.3	3.5	14.0	17.5
CD (P=0.05)	479.65	881.06	5.86	4.08	7.10	1.30	1.03	1.70	1.79	6.34	6.91

Table 3
Effect of weed management practices on grain yield, straw yield and economics of Drill sown finger millet

Treatments	*Total cost of cultivation (Rs ha^{-1})*	*Cost of weed control (Rs ha^{-1})*	*Gross returns (Rs ha^{-1})*	*Net returns (Rs ha^{-1})*
T_1	20005	1505	47953	27947
T_2	20110	1610	50339	30228
T_3	20222	1722	40166	19943
T_4	20393	1893	36741	16347
T_5	20162	1662	44180	24017
T_6	20319	1819	42642	22323
T_7	21415	2915	63754	42338
T_8	21990	3490	54006	32016
T_9	20901	2401	35437	14535
T_{10}	21305	2805	32106	10801
T_{11}	23700	5200	57733	34032
T_{12}	18500	-	15898	-2602

Correlation studies

Karl Pearson correlation coefficient values (r) were worked out for grain yield versus growth, yield components and weed parameters is presented in Table 4. The grain yield had significant and positive correlation with growth and yield parameters like plant height, number of tillers per hill, leaf area at 90 DAS and total dry matter production, number of productive tillers per hill, ear head length, weight of ear head, finger length and 1000 grain weight and also a significant and positive correlation between total nitrogen uptake, phosphorus uptake and potassium uptake and grain yield was observed. However, the grain yield was significant and negatively correlated with weed parameters like total weed density at maturity and weed biomass at maturity . There was a significant and negative correlation between grain yield and weed uptake *viz.*, N uptake, P uptake, K uptake (Table 4).

From the studies it can be concluded that pre-emergence application of Bensulfuron methyl (0.6% G) + Pretilachlor (6.0% G) @ 10 kg ha^{-1} recorded lower total weed population and their dry weight and nutrient uptake by weeds and pre-emergence application of Bensulfuron methyl (0.6% G) + Pretilachlor (6.0% G) at 7.5 kg ha^{-1} recorded higher grain and straw yield and nutrient uptake by drill sown ragi and also proved that economically viable practise.

Table 4
Correlation studies between grain yield and growth components, yield components, nutrient uptake and weed parameters in drill sown finger millet as influenced by weed management practices

Sl. No.	*Growth and yield attributes, nutrient uptake and weed parameters*	*Correlation coefficient (r)*
Growth parameters		
1	Plant height at maturity	0.991**
2	Leaf Area at 90 DAS	0.990**
3	Total Dry Matter at maturity	0.985**
Yield parameters		
4	No. of productive tillers per hill	0.965**
5	Ear head length	0.967**
6	Weight of ear head	0.933**
7	Finger length	0.970**
8	1000 grain weight	0.986**
Nutrient uptake by drill sown finger millet at maturity		
9	Nitrogen uptake	0.984**
10	Phosphorus uptake	0.963**
11	Potassium uptake	0.982**
Weed parameters		
12	Weed population at maturity	-0.814**
13	Weeds dry weight at maturity	-0.935**
Nutrient uptake by weeds at maturity		
14	Nitrogen uptake	-0.920**
15	Phosphorus uptake	-0.873**
16	Potassium uptake	-0.882**

** Correlation significant at P = 0.01

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