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WEED MANAGEMENT PRACTICES IN TRANSPLANTED KODOMILLET (*Paspalum scrobiculatum* L.)

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ABSTRACT
A field experiment was carried out at the Experimental Farm,Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu, India during *Kharif* season (June-October) 2014 to study the effect of weed management practices in transplanted kodo millet (*Paspalum scrobiculatum L.)*. The experiment consists of six viz., T_1 - Unweeded control, T_2 - Hand weeding on 20th and 40th days after transplanting (DAT), T_3 - Pre – emergence application of Butachlor @1.5 kg a.i /ha on 3 DAT, T_4 - Pre - emergence application of Pretilachlor @ 0.5 kg a.i/ ha on 3 DAT, T_5 - Post – emergence application of 2, 4, D- Na Salt @ 0.75 kg a.i/ha on 20 DAT and T_6 - Post – emergence application of Bispyribac- Sodium @ 20 g /ha on 20 DAT. The experiment was lay out in randomize block design with four replications. The results revealed that hand weeding on 20 and 40 DAT (T_2) significantly registered the tallest plant height of 90.32 cm. Highest grain yield of 2884 kg ha^{-1} was recorded with the hand weeding on 20 and 40 DAT (T_2). Similarly the highest straw yield (7881.48 kg ha^{-1}) was also observed from hand weeding on 20 and 40 DAT (T_2). Among the treatments, the highest nutrient uptake N (58.79 kg ha^{-1}), P (19.10 kg ha^{-1}) and K (75.72 kg ha^{-1}) was observed in the hand weeding on 20 and 40 DAT. The maximum available nutrients N (229.02 kg ha^{-1}), P (18.71 kg ha^{-1}) and K (284.35 kg ha^{-1}) were recorded from the treatment of hand weeding on 20 and 40 DAT. The highest B:C ratio (2.41) was recorded from the treatment T_6 *i.e.* post emergence application of bispyribac sodium @ 20 g ha^{-1} on 20 DAT. Thus, application of bispyribac sodium @ 20 g ha^{-1} on 20 DAT holds immense potentiality to control the all types of weeds, boost the productivity and profitability of transplanted kodo millet.

INTRODUCTION

Kodo (*Paspalum scrobiculatum L.)* is one of the major food crops in tribal areas of the country. It is widely distributed in damp habitats across the tropics and subtropics of the World. It is known to have been grown in southern Rajasthan and Maharashtra for at least 3,000 years (Kajale, 1977, De Wet *et al.,* 1983). It is grown today from Uttar Pradesh to Bangladesh in the north, and kerala and Tamil Nadu in the south. This cereal is known also as *varagu, kodo, haraka* and *arakalu*. It forms the main stay of the dietary nutritional requirements of farmers of marginal and dry lands in many parts of India. The fibre content of the whole grain is very high. Kodo millet has around 11% protein and the nutritional value of the protein has been found to be slightly better than that of foxtail millet but comparable to that of other small millets. As with other food grains, the nutritive value of kodo millet protein could be improved by supplementation with legume protein.

Kodo millet is grown in diverse soils, varying rainfall regimes and in area widely differing in thermo and photoperiods. The resilience exhibited by this crop is helpful in adopting themselves to different ecological niches. The major constraints are (i) Kodomillet is grown on poor shallow and marginal soils under rainfed conditions, which is still grown in the hilly areas under shifting cultivation, (ii) The soils on which this crop is cultivated have low moisture retention capacity and (iii) seeds are often broadcast and it is cultivated under unfertilized and unweeded conditions. Slow initial growth of kodo millet (*Paspalum scrobiculatum* L.) and favourable conditions for weed multiplication and a wide spectrum of heterogeneous weed flora, which gradually become a serious limitation for low production of kodo millet. Crops suffers from various biotic and abiotic constraints. Weed competition is one of the prime yield-limiting biotic constraints and weeds compete with crops for water, light, nutrients and space. Weeds are the most competitors in their early growth stages than at later stages and hence the growth of crops was suffered and finally reduced the grain yield (Jacob and Syriac, 2005).

Chemical method of weed control is effective to control the weeds economically. Now a days use of herbicides is gaining popularity due to their rapid effects and less cost involvement compared to traditional methods. Chemical method of weed control is economic and efficient method if applied at proper dose and stages (Kumar and Sharma, 2005). The use of herbicides offers selective control of weeds right from beginning, giving crop and advantage of good start and competitive superiority over weed (Saha, 2006).

Keeping these above said facts in consideration, the present investigation was carried out to study the effect of weed management on growth and yield of transplanted kodo millet. To study the effect of weed management on nutrient uptake by the crop and post-harvest soil available nutrient status.

MATERIALS AND METHODS

A field experiment was conducted at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu, India during *Kharif* season (June- October) 2014. The soil of the experimental field was clay with a pH of 7.9. The soil was low in available N, medium in available P_2O_5... and high in available K_2O. The experiment was laid out in randomized block design with four replications involving sowing methods as main plot treatments comprised of transplanting, whereas weed management practices comprised of five treatments viz., Unweeded control, Hand weeding on 20th and 40th days after transplanting (DAT), Pre – emergence application of Butachlor @1.5 kg a.i /ha on 3 DAT, Pre - emergence application of Pretilachlor @ 0.5 kg a.i/ ha on 3 DAT, Post – emergence application of 2, 4, D- Na Salt @ 0.75 kg a.i/ha on 20 DAT Post – emergence application of Bispyribac- Sodium @ 20 g / ha on 20 DAT. The mainfield was ploughed at optimum moisture condition with tractor mounted mould board plough followed by rotovator to break clods to get a fine tilth. Field was irrigated before transplanting, then seedling were uprooted from the nursery on 20 days after sowing and transplanted in the main field by adopting the spacing of 15 × 10 cm. The crop was sown on June 22nd during the *Kharif* season using kodo millet variety 'CO 3' at the seed rate of 10 kg/ha. The Kodomillet crop was fertilized with 44:22:0 kg of N, P_2O_5 and K_2O ha^{-1} in the form of urea (46% N) and DAP (18% N and 46% P_2O_5) during the crop. The entire dose of $P_2O_5$and half of the dose of N was applied as basal. The remaining half of N was top dressed in two equal splits at active tillering and flowering stage. The pre-emergence herbicides *viz.,* butachlor and pretilachlor were sprayed with knapsack sprayer fitted with a flood-jet nozzle. The pre-emergence herbicides were sprayed on the third day after transplanting. The post-emergence herbicide *viz.,* 2, 4, D - Na salt and bispyribac- sodium were sprayed on the twenty days after transplanting. Herbicides were mixed with a calibrated amount of water and sprayed plot wise. Total weed counts were recorded on 30 and 60 DAT from four quadrats each of area 0.25 m 0.25 m fixed permanently in sampling area of each treatment and expressed in number of weeds m^{-2}. The weed in the sample quadrats were collected from each plot separately on 30 and 60 DAT and roots were clipped off, oven dried at 80p C ± 5p C for 48 hours, a constant weight obtained and expressed in kg ha^{-1}. Observations on growth, yield attributes, yield and nutrient uptake were recorded. Soil samples were collected, dried and ground for chemical analysis. Soil pH was determined by using a glass electrode pH meter (Jackson, 1973). The total N content of the soil was determined by Kjeldahl method (Jackson, 1973), available P by ascorbic acid and blue colour method (Watanabe and Olsen, 1965) and available K by flame photometer (Jackson, 1973). Concentrated nitric acid was used for digestion of plant samples. Total P concentration was determined by Vanadomolybdate yellow colour method (Jackson, 1973), K concentration by Flame photometer method (Jackson, 1973).

Data obtained from the experiment was analysed by using the technique of analysis of variance (ANOVA) and the difference between treatment means was tested for their statistical significance with appropriate critical difference (CD) at 5 %level of probability (Gomez and Gomez, (1984).

RESULTS AND DISCUSSION

Effect of weed management on crop growth

The observations recorded on plant height on 30, 60 DAT and at harvest stages are presented in Table 1. The plant height was significantly influenced by various weed management practices. Among the treatments, hand weeding on 20 and 40 DAT significantly registered the tallest plant height of 39.29, 73.36 and 90.32 cm on 30, 60 DAT and at harvest stages, respectively and the minimum plant height was recorded in the unweeded control treatment. This is in line with the findings of Parthipan *et al*. (2013). The data recorded on number of tillers $hill^{-1}$ at maximum tillering stage. Tiller production was significantly influenced by various weed management practices. Hand weeding on 20 and 40 DAT recorded the highest number of tillers $hill^{-1}$ 14.12 and unweeded control recorded the least number of tillers $hill^{-1}$ of 5.23. Treatments altered the leaf area index at tillering and flowering stage of crop significantly in kharif season. Hand weeding on 20 and 40 DAT significantly registered the highest leaf area index of 1.53 and 4.74 and unweeded control recorded the lowest leaf area index of 0.89 and 2.93. This is in agreement with the findings of Surin *et al*. (2013). The crop dry matter production increased with the age of crop and

Table 1: Weed management practices on plant height, number of tillers $hill^{-1}$, leaf area index and dry matter production of transplanted kodo millet

Treatment	Plant height	Number of tillers $hills^{-1}$	Leaf area index		Dry matter production(kg ha^{-1})		
			Tillering	Flowering	Tillering	Flowering	Harvest
T_1	71.05	5.23	0.89	2.93	569	1785	4799
T_2	90.32	14.12	1.53	4.74	2640	4887	11971
T_3	80.12	9.53	1.20	3.90	1432	3278	7099
T_4	85.23	11.79	1.33	4.31	2064	4063	8038
T_5	76.02	7.33	1.05	3.50	1088	2550	5855
T_6	89.42	13.84	1.50	4.70	2598	4799	11915
S.Em(±)	1.28	0.24	0.02	0.10	28.50	55.01	176.89
C.D.(p = 0.05)	2.85	0.54	0.04	0.24	63.50	122.57	394.14

T_1- Unweeded controlT_2- Hand weeding on 20th and 40th days after transplantingT_3- Pre-emergence application of Butachlor @ 1.5 kg a.i/ha on 3 DATT_4- Pre-emergence application of pretilachlor @ 0.5 kg a.i/ha on 3 DATT_5- Post-emergence application of 2,4, D-Na salt @ 0.75 kg a.i/ha on 20 DATT_6- Post-emergence application of Bispyribac-sodium @ 20 g/ha on 20 DAT

Table 2: Weed management practices on Number of panicles hill^{-1}, number of grains panicle-^{1}, 1000 grain weight, grain yield and straw yield of transplanted kodomillet

Treatment	Number of panicles hill^{-1}	Number of grains panicle^{-1}	Test weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	B:C ratio
T_1	31.68	141.83	6.32	1295	2064	1.28
T_2	43.35	194.74	6.52	2884	7881	2.29
T_3	37.17	168.77	6.42	2058	5876	1.39
T_4	39.62	180.37	6.46	2432	6926	1.53
T_5	34.55	155.39	6.37	1669	4965	1.36
T_6	42.84	193.40	6.50	2825	7821	2.41
S.Em(±)	0.67	2.09	0.02	38.95	123.52	
C.D.(p=0.05)	1.50	4.65	NS	86.80	275.23	

T_1- Unweeded control; T_2- Hand weeding on 20th and 40th days after transplanting ;T_3- Pre-emergence application of Butachlor @ 1.5 kg a.i/ha on 3 DAT; T_4- Pre-emergence application of pretilachlor @ 0.5 kg a.i/ha on 3 DAT; T_5- Post-emergence application of 2,4, D-Na salt @ 0.75 kg a.i/ha on 20 DAT; T_6- Post-emergence application of Bispyribac-sodium @ 20 g/ha on 20 DAT

Table 3: Weed management practices on nutrient uptake (kg ha^{-1}), and post harvest soil available nutrient (kg ha^{-1}) of transplanted kodomillet

Treatment	Nutrient uptake (kg ha^{-1})			Available nutrient (kg ha^{-1}) of soil after the harvest of kodo millet		
	N	P	K	N	P	K
T_1	39.27	6.44	59.88	219	10.31	273
T_2	58.79	19.10	75.72	229	18.71	284
T_3	49.99	12.48	67.83	224	14.21	279
T_4	53.27	15.84	71.96	226	16.27	281
T_5	44.76	9.55	63.74	221	12.54	276
T_6	58.23	18.79	75.11	228	18.32	283
S.Em(±)	1.20	0.22	1.16	0.73	0.21	0.88
C.D.(p=0.05)	2.67	0.51	2.59	1.54	0.48	1.84

T_1- Unweeded control; T_2- Hand weeding on 20th and 40th days after transplanting; T_3- Pre-emergence application of Butachlor @ 1.5 kg a.i/ha on 3 DAT; T_4- Pre-emergence application of pretilachlor @ 0.5 kg a.i/ha on 3 DAT; T_5- Post-emergence application of 2,4, D-Na salt @ 0.75 kg a.i/ha on 20 DAT; T_6- Post-emergence application of Bispyribac-sodium @ 20 g/ha on 20 DAT

reached peak at maturity. Hand weeding on 20 and 40 DAT significantly recorded the highest crop dry matter production of 2640, 4887 and 11971 kg ha^{-1} on 30, 60 DAT and at harvest, respectively and the lowest dry matter production of 569, 1785 and 4799 kg ha^{-1} on 30, 60 DAT and harvest, respectively were recorded in unweeded control treatment. This is in accordance with the earlier findings of Laxminarayanan and Mishra (2001).

Effect of weed management on yield attributes and yield

In Table 2, among the treatments, hand weeding on 20 and 40 DAT significantly recorded the highest number of panicles hill^{-1} (43.35) and unweeded control recorded the lowest number of panicles hill^{-1} of (31.68). Hand weeding on 20 and 40 DAT significantly registered the higher number of grains panicle^{-1} 194.74 and unweeded control recorded the lowest number of grains panicle^{-1} of 141.83. The influence of weed management practices on 1000 grain weight was found to be non-significant. Among the treatments, hand weeding on 20 and 40 DAT significantly registered the highest grain yield of 2884 kg ha^{-1} which was 123 per cent increased over control and unweeded control recorded the lowest grain yield of 1295 kg ha^{-1}. Straw yield was significantly influenced by various weed management practices. Hand weeding on 20 and 40 DAT significantly recorded highest straw yield of 7881 kg ha^{-1} and unweeded control recorded the lowest straw yield of 2064. This might be due to increased production and translocation of photosynthatis to grains, owing to adequate availability of growth resources, as a result of less competition offered by weeds. Timely and effective control of weeds with use of pre and post emergence herbicides and better weed control resulted in increased yield components, which ultimately reflected on grain yield. These results are in conformity with those of Rawat *et al*. (2012).

Effect of weed management on nutrient uptake

Various treatments showed significant difference in nutrient uptake and residual nutrients of soil (Table 3). Among the treatments, the highest nutrient uptake was observed in the hand weeding recorded 58.79, 19.10 and 75.72 kg N, P and K ha^{-1}, respectively and the lowest nutrient uptake by kodomillet crop was recorded in unweeded control treatment with the values of 39.27, 6.44 and 59.88 kg N, P and K ha^{-1}, respectively. These results are in agreement with the finding of Amare *et al*. (2014) in wheat.

Effect of weed management on available nutrient of soil after the harvest of kodo millet

Post-harvest soil available nutrients of 229, 18.71 and 284 N, P and K kg ha^{-1}, respectively was highest recorded in hand weeding on 20 and 40 DAT. And the lowest post-harvest soil available nutrients was recorded in unweeded control treatment with the values of 219, 10.31 and 273 kg N, P and K kg ha^{-1}, respectively. Among different weed control treatments significantly the higher grain yield was recorded in sequential application of butachlor fb bispyribac sodium or 2,4-D sodium salt or hand weeding recorded the increased grain yield. Similarly with the finding of Mallikarjun *et al*. (2014) in rice. The straw yield was significantly influenced by different treatments. Two hand weeding produced the highest straw

yield and it was significantly superior to others. This is in agreement with the findings of Singh and Paikra, 2014.

Effect of weed management on economics

The highest B:C ratio (2.41) was recorded from the treatment T_6 i.e. post emergence application of bispyribac sodium @ 20 g ha^{-1} on 20 DAT. It was followed by the treatment hand weeding on 20 and 40 DAT (2.29).

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