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# Nutrients removal by weeds as influenced by the Integrated Weed Management practices in irrigated kodo millet (*Paspalum scrobiculatum* L.)

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**Abstract**
Field experiment was conducted at Millet Breeding Station, Tamil Nadu Agricultural University, Coimbatore to evaluate the Integrated Weed Management practices on Kodo millet under irrigated conditions. An experiment was conducted with eight treatments and replicated thrice in Randomized Block Design (RBD). The results showed that pre emergence application of isoproturon 750 g/ha followed by hand weeding at 40 days after sowing (DAS) recorded significantly lower weed density, lower dry weight and higher weed control efficiency. Hand weeding twice on 20 and 40 DAS and pre emergence application of isoproturon 750 g/ha followed by hand weeding on 40 DAS prevented the subsequent accumulation of dry weight of weeds through reduced weed density which led to decreased removal of soil nutrients.

**Keywords:** Integrated Weed, irrigated kodo, *Paspalum scrobiculatum* L.

## 1. Introduction
Kodo millet is an important minor millet in small millets. In Tamil Nadu, Kodo millet is cultivated in an area of 3340 ha, with the production of 4511 lakh tonnes and productivity of 1351 kg/ ha. (Status paper 2014 and Season Crop Report 2013) The productivity of kodo millet has been often deflated due to an array of biotic and abiotic factors. Weed competition is one of the major biotic constraints in realizing higher productivity. Initially the 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 (Prajapati *et al*., 2007) [10]. Weeds increase cost of cultivation and deplete the resource base (Buriro *et al*. 2003 and Upadhyay *et al*. 2012) [2, 14]. To get enhanced crop production and higher benefits from applied inputs, weeds must be kept under check by any of the safe and effective mean. Herbicide combinations are more effective weapons in tackling weed menace and thereby nutrient depletion by them than a single herbicide approach (Pisal and Sagarka 2013 and Upadhyay *et al*. 2013) [9, 15]. Therefore, present study works out nutrient removal by weeds as influenced by herbicide combinations in irrigated kodo millet.

## Materials and Methods
Field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore to evaluate integrated weed management practices against control of complex weed flora in irrigated kodo millet. The experiment was laid out in randomized block design with three replications. The treatments comprised of different weed management practices *viz*., PE pendimethalin 500 g/ha *fb* (followed by) HW on 40 DAS (Days After Sowing); PE bensulfuron + pretilachlor 660 g/ha; PE isoproturon 500 g/ha; PE pendimethalin 500 g/ha *fb* twin wheel hoe weeder weeding at 40 DAS; PE bensulfuron + pretilachlor 660 g/ha *fb* twin wheel hoe weeder weeding at 40 DAS; PE isoproturon 500 g/ha *fb* twin wheel hoe weeder weeding at 40 DAS; PE isoproturon 750 g/ha *fb* HW at 40 DAS; Hand weeding twice at 20 and 40 DAS; Twin wheel hoe weeder weeding at 20 and 40 DAS; Weed free check and Unweeded control.
Weeding was done as per treatment schedule. Herbicide treatment plots were applied with Pendimethalin 30% EC at 500g/ha, Bensulfuron + pretilachlor (0.06% + 0.6%) GR at 660 g/ha, Isoproturon 75% WP at 500 g/ha and 750 g/ha as pre-emergence spray on 3 DAS. Calculated quantity of herbicide with a spray fluid of 500 litres/ha was sprayed uniformly over the plots using knapsack sprayer fitted with deflector nozzle.

For mechanically weeded plots, same pre-emergence herbicides as per treatment schedule were applied followed by twin wheel hoe weeder weeding on 30 DAS in between the rows. Hand weeding was carried out at 20 and 40 DAS. The unweeded check was kept undisturbed for the entire cropping period.

Weed samples collected to assess dry matter production were ground to a fine powdered condition in a wiley mill and subjected to chemical analysis to assess the removal of N, P and K. The N, P and K removal at 20, 40 and 60 DAS were estimated. In the case of crop, N, P and K uptake at 30, 60, 90 DAS and at harvest were estimated. N, P and K uptake of weed and crop was estimated as per standard procedures given in the Table. Nutrient content of the samples were multiplied with their respective DMP to arrive at nutrient uptake and expressed in kg/ha.

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Percentage of nutrient} \times \text{Total dry matter production (kg/ha)}}{100}$$

Observations were recorded on weed characters like weed flora

| Nitrogen | Kjeldhal method | Humphries (1956) |
|---|---|---|
| Phosphorus | Triple acid digestion with colorimetric estimation | Jackson (1973) |
| Potassium | Triacid digestion with flame photometric method | Jackson (1973) |

The data on nutrients removal by the weeds in the experimental field were statistically analysed as suggested by Dhamu and Ramamoorthy (2007) [5]. The data pretaining to weed density and dry weight showed high variation and were subjected to square root transformation $\sqrt{(X + 0.05)}$ and analyzed statistically.

## Results and Discussion

### Weed flora

The general weed flora of the experimental field during the cropping period primarily composed of grasses, sedge and broad leaved weeds. The weed flora of the experimental field consisted of *Brachiaria reptans, Acrachne racemosa, Dactyloctenium aegyptium, Panicum repens* under grasses, *Cyperus rotundus* under sedge and *Trianthema portulacastrum, Boerhaavia diffusa, Parthenium hysterophorus, Digeria arvensis, Tribulus terrestris* under broad leaved weeds. Dominance of such wide spectrum of weeds was also reported by many workers (Ramamoorthy *et al*., 2002; Kumara *et al*., 2007; and Basavaraj patil *et al*., 2014) [11, 8, 1].

The predominant occurrence of these weed species in kodo millet could probably be attributed to the ecological adaptation and dominance of the above listed weeds in sandy clay loam soils of Coimbatore region. Among the weeds, sedge weed was predominant and constituted about 45.07 per cent followed by broad leaved weeds of 42.54 per cent, among them, *Trianthema portulacastrum* was the dominant species of about 20.84 per cent followed by *Parthenium hysterophorus* of 8.03 per cent. Next to broad leaved weeds, grassy weeds accounted for 12.39 per cent in which *Dactyolactenium aegyptium* was the dominant species 7.69 per cent than other species Channa naik *et al.* (2001) [4].

### Nutrient removal by weeds

Nutrient removal by weeds played a important role in the irrigated kodo millet production. The integrated weed management practices adopted greatly influenced the nutrient (nitrogen, phosphorus and potassium) removal and it was significantly varied during all growth stages of the crop.

### Nitrogen removal

Nitrogen removal by weeds was significantly influenced by different treatments and is presented in the Table. The efficiency of the weed control treatment and the nutrient uptake by weeds was negative to each other. Integrated Weed Management (IWM) practices *viz.*, pre-emergence herbicide + hand weeding lowered the weeds number than other practices. Among the herbicide treatments, pre emergence application of isoproturon 750g/ha *fb* HW on 40 DAS registered significantly lower nirogen removal by weeds (2.49 kg/ha) which was comparable with pre emergence application of pendimethalin at 500g/ha and PE isoproturon 500 g/ha *fb* Twin wheel hoe weeder weeding at 40 DAS at 20 DAS. Hand weeding at 20 and 40 DAS registered distinctly lower N removal by weeds of 2.81, and 2.51 kg/ha and was comparable with that in pre emergence application of isoproturon 750 g/ha *fb* HW on 40 DAS at 40 and 60 DAS. N removal by weeds was moderate in pre emergence application of isoproturon 500g/ha alone or with twin wheel hoe weeder weeding at 40 DAS, pre emergence application of pendimethalin 500g/ha *fb* HW on 40 DAS, pre emergence application of pendimethalin at 500g/ha *fb* twin wheel hoe weeder weeding at 40 DAS and twin wheel hoe weeder weeding at 20 and 40 DAS which were comparable with each other at all stages of observation except 20 DAS. Distingly higher N removal of 7.02, 13.22, 18.45 kg/ha was registered with unweeded control at 20, 40 and 60 DAS respectively.

### Phosphorus removal

The integrated weed management practices showed noticeable influence on phosphorus removal by weeds Significant variations were observed between treatments in reducing the P uptake by weeds. Similar to N removal by weeds, the P removal was significantly lower in pre emergence application of isoproturon 750g/ha *fb* hand weeding on 40 DAS (0.85 kg/ha) which was comparable with pre emergence application of isoproturon 500 g/ha and pre emergence application of isoproturon 500 g/ha *fb* Twin wheel hoe weeder weeding at 40 DAS at 20 DAS. Hand weeding on 20 and 40 DAS recorded distinctly lower P removal by weeds (1.51 and 1.35 kg/ha) and was comparable with pre emergence application of isoproturon 750 g/ha *fb* HW on 40 DAS, pre emergence application of isoproturon 500 g/ha *fb* Twin wheel hoe weeder weeding at 40 DAS at 40 and 60 DAS and pre emergence application of isoproturon 500 g/ha only at 40 DAS. Moderate P removal was observed in pre emergence application of isoproturon 500 g/ha, pre emergence application of pendimethalin 500 g/ha *fb* hand weeding on 40 DAS, pre emergence application of pendimethalin 500 g/ha *fb* Twin wheel hoe weeder weeding at 40 DAS and Twin wheel hoe weeder weeding at 20 and 40 DAS which were comparable with each other at 40 and 60 DAS. Conspicuously higher P removal of 3.03, 5.52, 9.34 kg/ha was registered with unweeded control at 20, 40 and 60 DAS respectively.

### Potassium removal

There was significant reduction in K depletion by weeds among different weed management practices. Among the weed management practices, pre emergence application of isoproturon at 750g/ha *fb* hand weeding on 40 DAS exerted

significant influence in reducing the K removal by weeds (1.68 kg/ha) and was comparable with pre emergence application of isoproturon 500g/ha alone or with twin wheel hoe weeder weeding at 40 DAS at 20 DAS. Hand weeding on 20 and 40 DAS recorded distinctly lower K removal by weeds (2.29 and 1.57 kg/ha) and was comparable with pre emergence application of isoproturon 750 g/ha *fb* HW on 40 DAS, pre emergence application of isoproturon 500 g/ha *fb* Twin wheel hoe weeder weeding at 40 DAS at 40 and 60 DAS and pre emergence application of isoproturon 500 g/ha only at 40 DAS. Comparable control of K removal was observed in PE isoproturon 500 g/ha, pre emergence application of Pendimethalin 500 g/ha *fb* HW on 40 DAS and Twin wheel hoe weeder weeding at 20 and 40 DAS which were comparable with each other at 40 and 60 DAS. Unweeded control registered significantly higher K removal by weeds (4.10, 9.16 and 13.63 kg/ha on 20, 40 and 60 DAS respectively). Weeds being a deliberate adverse factor in the crop production which are liable for marked losses of crop yields. Weeds that grow with crop plants deplete considerable amount of applied fertilizer nutrients in addition to available soil moisture. Generally, the extent of nutrient loss varies from 30 to 40 per cent of the applied nutrients depending upon the weed flora composition and method of weed control. Effective weed control methods provide a conducive environment for increased uptake of nutrients by crop with proportionate decrease in the depletion of nutrients by weeds. As far as nutrient removal by weeds is concerned, competition for nutrients constitutes an important aspect of crop-weed interference. In this experiment, the pattern of nutrient removal by weeds showed that the nutrient loss due to weeds was minimum wherever effective weed control was possible (Fig.1). The loss of nutrients by weeds varied with intensity of weeds and weed dry weight accumulation. Hand weeding twice on 20 and 40 DAS and pre emergence application of isoproturon 750 g/ha *fb* hand weeding on 40 DAS prevented the subsequent accumulation of dry weight of weeds through reduced weed density which led to decreased depletion of soil nutrients. This is in accordance with the findings of Channa Naik *et al*. (2000) [3] who confirmed that N, P and K removal by weeds was limited in herbicide applied plots compared to unweeded control. Due to uncontrolled weed growth, removal of N, P and K was higher in weedy check which resulted in increased dry weight of weeds.

**Table 1:** Effect of Integrated Weed Management practices on Nitrogen removal by weeds (kg/ha) in Irrigated Kodo millet

| Treatment | Nitrogen removal by weeds (kg/ha) | | | Phosphorus removal by weeds (kg/ha) | | | Potassium removal by weeds (kg/ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 20 DAS | 40 DAS | 60 DAS | 20 DAS | 40 DAS | 60 DAS | 20 DAS | 40 DAS | 60 DAS |
| PE pendimethalin 500 g/ha *fb* HW on 40 DAS | 3.52 | 4.70 | 4.47 | 1.40 | 2.23 | 2.07 | 2.30 | 3.38 | 2.84 |
| PE bensulfuron + pretilachlor 660 g/ha (RM) | 4.10 | 8.96 | 10.2 | 2.21 | 4.33 | 4.12 | 2.65 | 4.43 | 3.94 |
| PE isoproturon 500 g/ha | 2.83 | 4.45 | 4.36 | 1.14 | 1.93 | 2.07 | 1.92 | 2.72 | 3.18 |
| PE pendimethalin 500 g/ha *fb* Twin wheel hoe weeder weeding at 40 DAS | 3.78 | 5.20 | 4.95 | 1.42 | 2.27 | 2.16 | 2.33 | 3.41 | 2.87 |
| PE bensulfuron + pretilachlor 660 g/ha (RM) *fb* Twin wheel hoe weeder weeding at 40 DAS | 3.91 | 7.47 | 6.88 | 2.19 | 4.28 | 3.43 | 2.62 | 4.40 | 3.70 |
| PE isoproturon 500 g/ha *fb* Twin wheel hoe weeder weeding at 40 DAS | 2.76 | 4.33 | 4.04 | 1.10 | 1.90 | 1.75 | 1.70 | 2.69 | 2.15 |
| PE isoproturon 750 g/ha *fb* HW on 40 DAS | 2.49 | 3.75 | 3.41 | 0.85 | 1.64 | 1.48 | 1.68 | 2.42 | 2.05 |
| Hand Weeding twice at 20 and 40 DAS | 5.27 | 2.81 | 2.59 | 2.87 | 1.51 | 1.35 | 3.97 | 2.29 | 1.97 |
| Twin wheel hoe weeder weeding at 20 and 40 DAS | 5.03 | 4.98 | 4.72 | 2.94 | 2.05 | 1.98 | 4.03 | 3.02 | 2.89 |
| Weed free check | 0.0 | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unweeded control | 7.02 | 13.22 | 18.45 | 3.03 | 5.52 | 9.34 | 4.10 | 9.16 | 13.63 |
| **SEd** | **0.38** | **0.53** | **0.63** | **0.18** | **0.24** | **0.26** | **0.25** | **0.32** | **0.37** |
| **CD (P=0.05)** | **0.80** | **1.11** | **1.31** | **0.38** | **0.51** | **0.55** | **0.52** | **0.67** | **0.77** |

**PE** – Pre emergence **HW** - Hand weeding ***fb*** – followed by **DAS** – Days After Sowing **RM** – Ready Mix

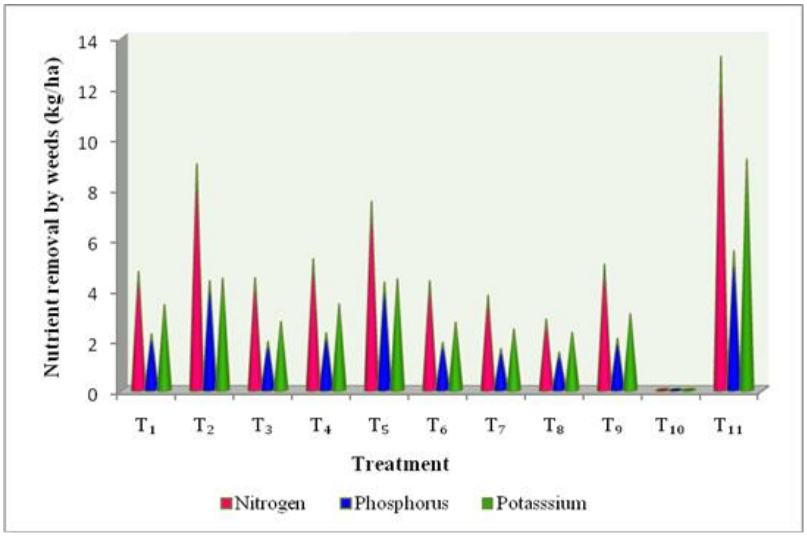


**Fig 1:** Effect of integrated weed management practices on nutrient removal by weeds (kg/ha) in irrigated kodo millet

## Conclusion

From the experimentation, it is concluded that pre emergence application of isoproturon 750 g/ha followed by hand weeding on 40 days after sowing and hand weeding at 20 and 40 days after sowing practices drastically reduced the nutrients removal from the soil and also enhance the productivity of irrigated kodo millet.

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