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Effect of Weed Management Practices on Weed Dynamics, Yield and Economics of Sweet Potato (*Ipomoea batatas* L.)

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Abstract

An experiment was conducted to find out the most suitable weed management practice for weed management in sweet potato during 2015-16 at Agricultural Research Farm, Dholi of Dr. Rajendra Prasad Central Agricultural University, Pusa (Bihar) under sandy loam soil. It was found that the herbicide Quizalofop-p-ethyl alone or in combination with other herbicides performed better than all other herbicides tested. It may be due to its better efficacy towards controlling narrow leaved weeds particularly against the most dominant weed of the field *Sorghum halepanse*. The most effective combination of herbicides was pendimethalin followed by quizalofop-p-ethyl (T_7) which may be due to weed control right from the early stage up to about a month by the application of pendimethalin and thereafter control of most dominating and vigorous weed *Sorghum halepanse* by the application of quizalofop-p-ethyl. Although lowest weed population and weed dry matter at 30 and 60 days after planting were recorded under T_{10} (Hand weeding twice at 20 & 40 days after sowing) and was significantly superior than all other treatments, it could not achieve highest net return and B : C ratio even after realizing highest tuber yield (20.3 t ha^{-1}). Best weed index (9.36 %) was recorded by the treatment combination of pendimethalin (T_1) followed by quizalofop-p-ethyl (T_7) and it was equally good with hand weeding twice (T_{10}) with respect to tuber yield. Significant highest net return (₹ 115226 ha^{-1}) was recorded by T_7 than all other treatments but was found on par with T_{10} (₹ 111826 ha^{-1}). B : C ratio recorded by T_7 (3.60) was significantly superior than the other treatments. Highest weed population, weed dry matter, weed index and lowest tuber yield, net return and B : C ratio were recorded under control treatment.

Key words : Sweet potato, weed management, herbicides, tuber yield, net return.

Introduction

Sweet potato (*Ipomoea batatas* L.) is one of the most important tuber crops of India and the world as well. It is also an important tuber crop grown in Bihar. In the present scenario of changing climate, it has assumed more importance than before due to some unparallel edges over other crops like its capacity to produce even in adverse climatic conditions without affecting much on its productivity, high yield potential and feed for animals within short period of time. Its farming is also eco-friendly because of less use of agro-chemicals. It ranked fifth economically after rice, wheat, maize, and cassava; sixth in dry matter production; seventh in energy production and ninth in protein production in the world, and is the second most economically important tuber after Irish potato in Sub-Saharan Africa (Momanyi et al., 2016). The yield potential of sweet potato is seriously affected by weeds competing for nutrients, water, light and space. Hand weeding is generally done by the farmers but due to scarcity and unavailability of labourers during peak period, increasing labour wages, time consuming and cumbersome operations, it becomes imperative to go for chemical weed control (Singh et al., 2014). Weed management is necessary especially during initial period

of about two months of crop growth. Keeping these facts this experiment was undertaken.

Materials and Methods

The experiment was conducted at Agricultural Research Farm, Dholi of Dr. Rajendra Prasad Central Agricultural University, Pusa (Bihar) during 2015-16. The soil of the experimental plot was sandy loam with pH 8.2. Initial soil analysis value of the experimental field was as follows: available nitrogen (218.4 kg ha^{-1}), phosphorus (17.6 kg ha^{-1}), and potassium (138.5 kg ha^{-1}); zinc (0.48 mg kg^{-1}) and boron (0.40 mg kg^{-1}). The experiment consisted of eleven treatments i.e., T_1 : Pendimethalin @ 1.0 kg ha^{-1} (PE - Pre-emergence : 2 days after planting (2 DAP), T_2 : Quizalofop-p-ethyl @ 75 g ha^{-1} (PoE : Post-emergence - 25 DAP), T_3 : Quizalofop-p-ethyl @ 100 g ha^{-1} (PoE : Post-emergence - 25 DAP), T_4 : Imazethapyr @ 50 g ha^{-1} (PoE : Post -emergence : 15 days after planting (15 DAP), T_5 : Imazethapyr @ 75 g ha^{-1} (PoE : Post - emergence : 15 days after planting (15 DAP) , T_6: Halosulfuron @ 67.5 g ha^{-1} (Early Emergence : 10 DAP), T_7 : T1 + T2, T_8 :T1 + T4, T_9 :T6 + T2, T_{10} : (HW) (20 and 40 days after planting (DAP)) and T_{11} : Control. The experiment was laid out in randomized block design with three replications. Sweet potato variety RS-92 was taken as test variety and the vines of which was planted at a spacing of 30 cm x 30 cm. Recommended dose of manures and fertilizers i.e., 15.0 t ha^{-1} of compost with chemical fertilizers @ 60: 40: 60 N:P_2O_5:K_2O kg ha^{-1} were applied uniformly in all the treatments. Other standard package of practices were also followed as per the schedule. Weed samples were taken at 30 and 60 days after planting randomly from three places using a quadrate of 0.25 m^2 and converted into weed population m^{-2}. Thereafter, weeds were oven dried and recorded as weed dry weight m^{-2}. The most dominating weed was *Sorghum halepanse.* Other important weeds found were *Cynodon dactylon, Cyperus rotundus, Physallis minima, Cannabis sativa, Convolvulus arvensis, Anagallis arvensis,* etc. Tubers were harvested from net area of 9.0 m^2 and converted into t ha^{-1}. Net returns and B : C ratio were also worked out. The data were analyzed by following the standard statistical procedures.

Results and Discussion

Effect on weed dynamics

Herbicides alone or in combinations when applied and the hand weeding twice (20 and 40 DAP) produced significant effect on weed population, weed dry biomass, weed index, tuber yield, net return and B:C ratio of sweet potato (Table1). Significantly lowest value of weed population and dry weight at 30 and 60 DAP and highest tuber yield were recorded under two hand weeding at 20 and 40 DAP (Fig. 1). This may be due to removal of weeds at proper time that could have provided favourable conditions for the growth of the plant which ultimately resulted into highest tuber yield. The increase in tuber yield was to the tune of 181.9 per cent in T_{10} and 155.6 per cent in T_7 with respect to control treatment. Weed population was significantly affected by different weed management practices. Significant highest weed population at 30 DAP was recorded in control treatment (103.7 m^{-2}) over rest of the treatments simply because none of the weed management practices were done, in

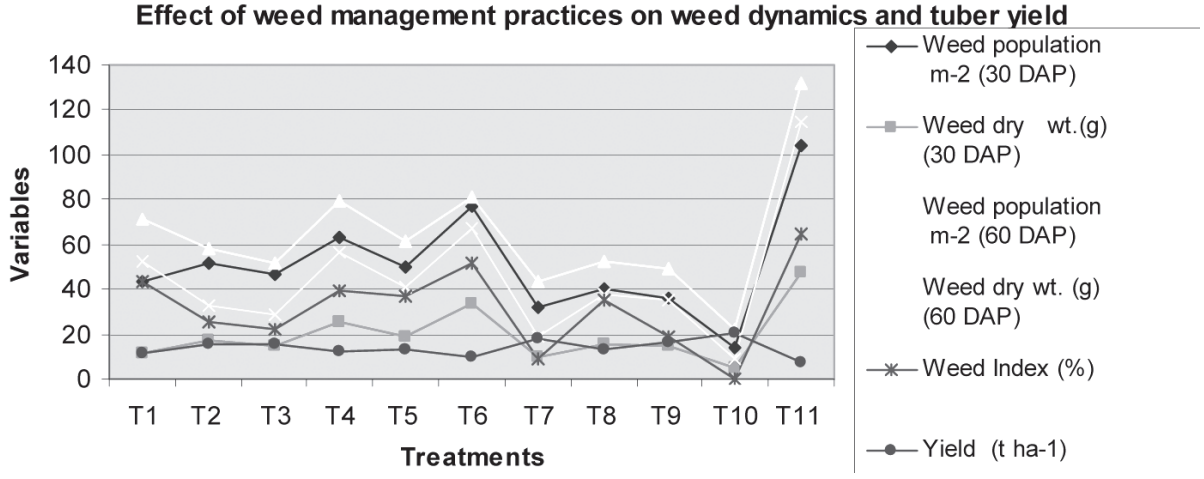

Fig.1. Effect of weed management practices on weed dynamics and yield of sweet potato.

Table 1. Effect of weed management practices on weed dynamics, yield and economics of sweet potato.

Treatments	Weed population m^{-2}(30 DAP)	Weed dry wt. (g)(30 DAP)	Weed population m^{-2}(60 DAP)	Weed dry wt. (g) (60 DAP)	Weed index (%)	Yield (t ha^{-1})	Net returns Rs. ha^{-1})	B:C ratio
T_1 : Pendimethalin @ 1.0 kg ha^{-1} (PE - 2 DAP)	43.6	11.2	71.4	52.8	43.35	11.5	62768	2.15
T_2 : Quizalofop-p-ethyl @ 75 g ha^{-1} (PoE - 25 DAP)	51.7	17.6	58.1	33.1	25.12	15.2	91538	3.04
T_3: Quizalofop-p-ethyl @ 100 g ha^{-1} (PoE - 25 DAP)	46.4	14.8	51.7	28.4	22.17	15.8	95424	3.08
T_4 : Imazethapyr @ 50 g ha^{-1} (PoE - 15 DAP)	63.3	25.3	79.3	56.3	39.41	12.3	70342	2.51
T_5 : Imazethapyr @ 75 g ha^{-1} (PoE - 15 DAP)	50.2	18.6	61.8	40.8	36.95	12.8	73960	2.60
T_6: Halosulfuron @ 67.5 g ha^{-1} (EE - 10 DAP)	76.8	33.8	81.2	67.4	51.23	9.9	51128	1.82
T_7:T1 + T2	32.3	9.7	43.4	19.1	9.36	18.4	115226	3.60
T_8 :T1 + T4	40.5	15.8	52.6	37.3	35.47	13.1	74804	2.49
T_9 :T6 + T2	36.4	14.6	48.8	35.6	18.72	16.5	99262	3.03
T_{10}: Hand Weeding (20 and 40 DAP)	14.2	4.8	22.5	8.6	—	20.3	111826	2.21
T_{11} : Control	103.7	47.7	131.9	114.8	64.53	7.2	30306	1.11
CD (0.05)	8.3	3.1	8.9	4.2	-	2.6	10638	0.51

spite all the supplemental inputs (manures, fertilizers, irrigation etc.) were given like other treatments. Significant highest reduction in weed population was in the treatment where hand weeding was done twice (T_{10}) and the weed reduction was to the tune of 86.3 per cent followed by 68.8 per cent in the treatment where combination of pre and post emergence herbicides were applied (pendimethalin + quizalofop-p-ethyl - T_7). Weed dry weight at 30 DAP followed similar trend. At 60 DAP, weed population and weed dry weight were also influenced significantly due to different weed management practices. Weed population (131.9 m^{-2}) and weed dry weight (114.8 g m^{-2}) were found significantly higher under control treatment than the other treatments. Weed population and weed dry weight were significantly reduced in the treatment of hand weeding twice and the reductions were to the tune of 82.9 and 92.5 per cent, respectively.

Highest weed index (64.53 %) was worked out in control treatment because of the lowest tuber yield realized which is mainly due to severe competition of sweet potato with the unchecked weed growth for the below and above growth factors (Table1; Fig.1). Among different weed management practices, the lowest weed index (9.36 %) was recorded in treatment where combination of pre and post emergence herbicides were applied (pendimethalin + quizalofop-p-ethyl - T_7) which reduced the weed population effectively right from early stage up to the critical stage and provided favourable conditions to plants and resulted in equal (at par) tuber yield to that obtained in twice hand weeded treatment which ultimately resulted in the lowest weed index and the reduction was to the tune of 85.5 per cent.

Effect on tuber yield

Tuber yield was also influenced significantly due to different weed management practices (Table1; Fig. 1). Tuber yield (20.3 t ha^{-1}) recorded in plot of hand weeded twice at 20 and 40 DAP was significantly superior than all other weed management practices except the plot where pendimethalin + quizalofop-p-ethyl were applied as pre and post emergence herbicides. This might be due to early control of weeds up to about one month by

the application of pendimethalin and thereafter effective control of the most prevalent weed of the field *Sorghum halepanse* and other narrow leaved weeds by the application of quizalofop-p-ethyl which provided congenial conditions for the growth of sweet potato plants. Highest tuber yield recorded in T10 was may be due to the effective weed conttol up to the critical period of crop growth from weed competition and loosening of soil favoured aeration in the root zone of sweet potato during hand weedings. Significant lowest tuber yield (7.2 t ha^{-1}) was recorded in control plot mainly due to severe competition of sweet potato plants for nutrients, light, moisture, space and air with unchecked weeds. Reduction in tuber yield was to the tune of 64.5 per cent. The next significant reduction in tuber yield (9.9 t ha^{-1}) was recorded in plot where halosulfuron was applied as early emergence 10 days after planting (T_6) which might be due to control of only weeds of *Cyperus species* and that had no effect on most of the weeds of the plot particularly on the most prevalent weed (*Sorghum halepanse*) of the plot. Yield reduction was to the tune of 51.2 per cent.

Effect on economics

Similarly, net return was significantly affected by different weed management practices (Table1; Fig. 2). Net return obtained in T_7 (pendimethalin + quizalofop-p-ethyl) was significantly superior (Rs. 115226 ha^{-1}) than that of all other weed management practices except T_{10} where hand weeding was done twice at 20 and 40 days after planting. The reason may be higher cost of production in T_{10} than in T_7 although the tuber yield recorded under T_{10} was numerically higher than T_7. Lowest net return was worked out in control plot (Rs.30306 ha^{-1}) because of the significant lowest tuber yield realized therein. Reduction in net return was to the tune of 75.9 per cent as compared to the significant highest net return obtained in T_7.

B : C ratio did not follow the same pattern as that of tuber yield and net return (Table1; Fig. 3).Although the

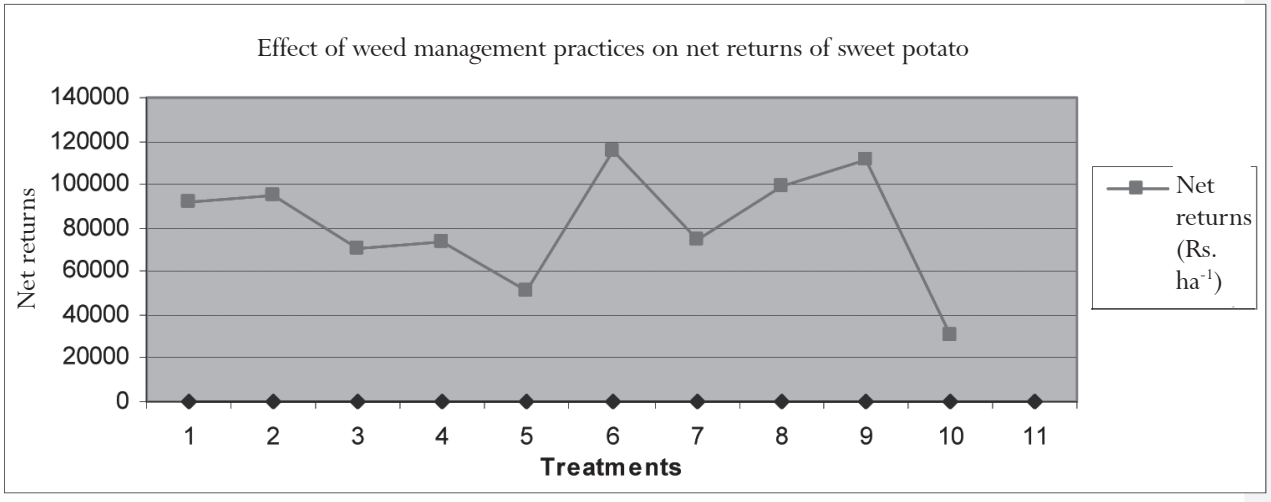

Fig. 2. Effect of weed management practices on net return of sweet potato.

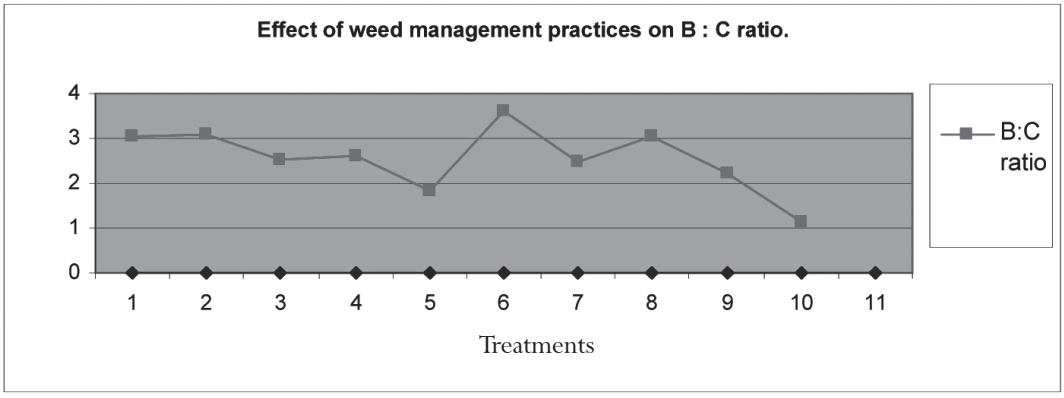

Fig. 3. Effect of weed management practices on B : C ratio of sweet potato.

highest tuber yield was realized under two hand weeding treatment (T_{10}) but due to the highest cost of cultivation incurred upon, it could not resulted in highest net return and B:C ratio. Highest B:C ratio (3.60) was estimated in T7 where pendimethalin was applied as pre-emergence and followed by quizalofop-p-ethyl as post-emergence which was resulted into control of weeds right from early stage up to critical period of weed competition by the application of pendimethalin and quizalofop-p-ethyl which provided congenial conditions for the growth of sweet potato plants that ultimately helped in realization of tuber yield at par with the best treatment and the highest net return. Significant highest B:C ratio in this treatment was due to the highest net return and comparatively lower cost of cultivation. Lowest B:C ratio (1.11) was worked out in control treatment and it was to the tune of 34.6 per cent lower.

Conclusion

Based on the findings of this experiment, spraying of pendimethalin @ 1.0 kg ha^{-1} (pre-emergence) + quizalofop-p-ethyl @ 75 g ha^{-1} (post-emergence) can be suggested to farmers for effective weed management particularly where grassy weeds are predominant.

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