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Evaluation of Weed Management Options to Enhance Sweet Potato Production in Kenya

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The sweet potato (*Ipomoea batatas* (L.) Lam) crop, once established, requires little field management apart from weed control. Weeds are minimized by a combination of hand-weeding, inter-row cultivation and herbicide application. In this study, mulching, pre-emergent herbicide application, weeding and control (unweeded) treatments were examined in field trials at KALRO- Muguga South and at Siaya Agricultural Training Centre (ATC) during long and short rains seasons of 2014. SPK 004 and Kemb 10 varieties grown at Muguga yielded highest (29.54 and 21.72 tons/ha, respectively) when weeded twice, which was significantly (P< 0.05) more than other treatments. Cuny-Kibuonjo and Bungoma varieties planted in Siaya had significantly (P< 0.001) higher yields (33.28 and 30.68 tons/ha) when mulched as compared to other treatments. There were very high significant (P< 0.001) reduction in weed density, biomass and dry matter where mulching, weeding and spraying a pre-emergent herbicide was done as compared to the control unweeded plots.

Keywords: *Sweet potato, Mulching, Weeding, Herbicide*

1. Introduction

Sweet potato is one of the most important staple food crops in Kenya. It plays a significant role as a food security and commercial crop. The crop can be harvested in piece meal and stored (Ekanayake, 1990). The storage tubers are boiled and eaten or chipped, dried and milled into flour used to prepare snacks and baby weaning foods (Kidmose *et al*., 2007). Sweet potato is dried and made into flour that can be used to make porridge, or mixed with wheat flour and baked to produce bread. The flour is also used to make snacks and desserts such as pies, puddings, biscuits, cakes, chips, crisps, mandazis, and chapatis. In addition, fresh storage tubers are sold in open markets to generate income and or canned for export markets. Sweet potato tubers are also used as a raw material to produce starch and vines are used as livestock feed (Claessens *et al*., 2007). Consumption of yellow and orange fleshed sweet potato rich in pro-vitamin A can help reduce vitamin A deficiency (Ishiguro *et al*., 2007); (Stathers et al., 2005). Sweet potato has a great yield potential of 20-50 t/ha of root dry weight in the tropics (Nweke 1998). However production in African countries falls way below the expected maximum yield potential since farmers produce an average of less than 10t/ha (Nweke 2002). Low production is mainly due to abiotic factors such as drought and soil nutrition deficiencies, and biotic diseases and pests such as the sweet potato weevil, weeds and nematodes. Weed management is a critical, costly and a major constraint to successful sweet potato production since weeds compete with the crop for nutrients, water and sunlight causing losses as high as 50–60% (Stall, 2010). Weed control is necessary during the first 2 months when plant growth is slow (Lewthwaite and Triggs, 2000). Integrated weed management (IWM) approach such as mechanical, cultural and use of herbicides for crops grown on large acreages is needed to effectively control weeds during early stages of growth when competition is high to enhance production (Mwanda, 2000). The objective of this research was to evaluate and promote effective weed management technologies for enhancing sweet potato production in Kenya.

2. Materials and Methods

Trials were planted in fields at KALRO- Muguga South and Siaya Agricultural Training Centre (ATC) in August 2014 and harvested in December 2014. SPK 004 and Kemb 10 varieties were planted at KALRO- Muguga South while Cuny-Kibuonjo and Bungoma at Siaya ATC. The five treatments; mulching, pre-emergent herbicide application, weeding twice, weeding once and the control (no weeding) applied to the varieties were replicated three times and arranged randomly. The trial plots were four (4) rows wide by three (3) m long. Each row was 0.75 m wide and within-row plant spacing was 0.30 m. Data on crop growth parameters was collected monthly in an area of $0.5m^2$, for weed count and biomass in 1x1 m^2. A combination of Lasso and Farmuron herbicides were applied at a rate of 1.2L/ha and 0.7kg/ ha, respectively, four (4) days before planting vines. A well calibrated hand-operated backpack Hardy sprayer was used to apply the herbicides. Mulching treatment was applied immediately after planting the vines while weeding treatments were done during first and second months after planting. Crop and weed biomass for each treatment were collected and transported in polythene papers to the National Agricultural Research Laboratories (NARL). They were air dried on open benches for five days then dried in an oven at a temperature of 70°C for 48hrs to obtain dry matter. Harvesting was done from two middle rows in an area of $1m^2$ (8 plants) but not from the outer buffer plants and rows (guard plants and rows).

3. Results and Discussion

Tuber weight for SPK 004 and Kemb 10 varieties planted in KALRO- Muguga South were significantly affected by the treatments (P< 0.05). Both varieties yielded the highest (29.54 and 21.72 tons/ha, respectively) when weeded twice, followed by when mulched (Figure 1).

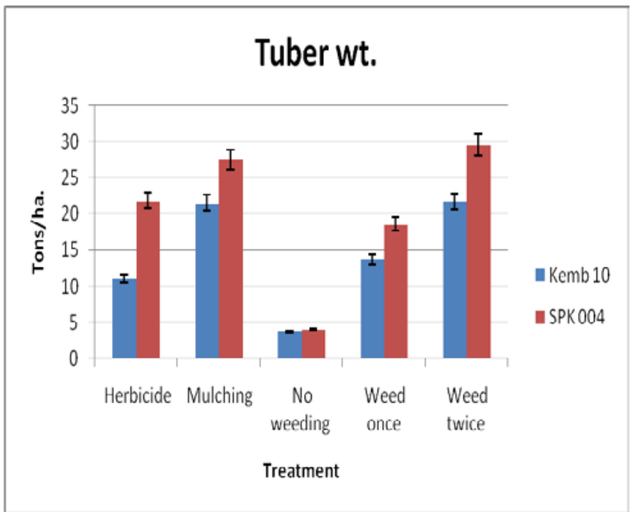

Fig.1 Tuber weight of varieties planted at Muguga

In addition, there were very high significant (P< 0.001) differences in tuber weight for both Cuny-Kibuonjo and Bungoma varieties planted at Siaya ATC. Both varieties yielded the highest (33.28 and 30.68 tons./ha., respectively) in mulched plots followed by plots where weeding was done twice (Figure 2). Mulching proved a better option, and this can be applied especially in areas which receive low rainfall since mulch could conserve soil moisture and also lower soil temperature thus favouring the growth of the crop.

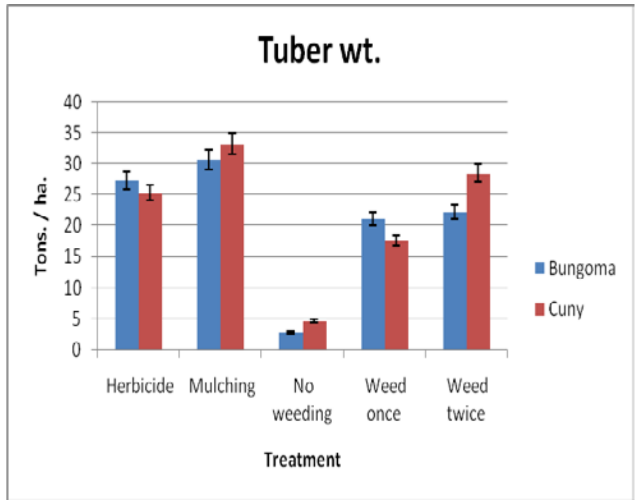

Fig.2 Tuber weight of varieties planted at Siaya

Controlling weeds through weeding and mulching reduced weed density and thus competition with the crop. This promoted crop growth (biomass and thus ground cover) which in turn increased yield (tuber weight). Low yield in the control plots was attributed to weeds which competed with the crop for nutrients and water (Stall, 2010). This reduced biomass and ground cover that in turn reduced the yield. Ground cover and crop biomass were highly affected by the treatment applied. High significant differences were observed (P > 0.01) among treatments for both varieties (SPK 004, Kemb 10) planted at KALRO- Muguga South, Cuny- Kibuonjo and Bungoma varieties planted in Siaya. Although the four varieties had the highest ground cover when mulched, SPK 004 variety had the highest mean crop biomass weight (29.22 tons/ ha.) when weeded twice while Kemb 10 had 10 15.86 when mulched (Fig. 3).

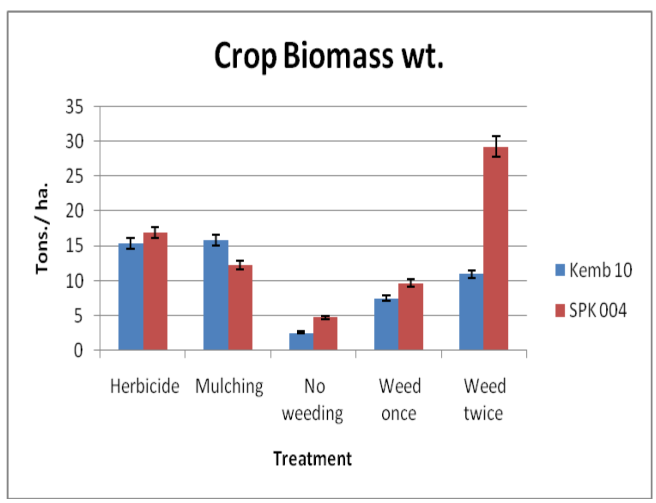

Fig. 3: Crop biomass of varieties planted at Muguga

On the other hand, both Cuny-Kibuonjo and Bungoma varieties had the highest crop biomass weight (39.18 and 28.2 tons./ ha., respectively) when mulched (Fig. 4).

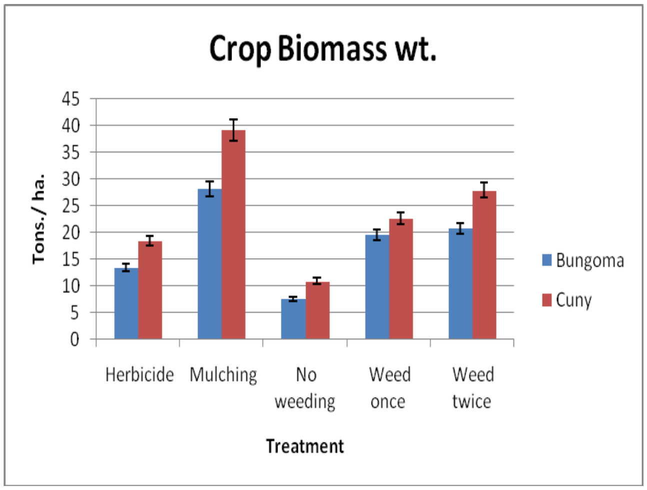

Fig. 4: Crop biomass of varieties planted at Siaya

Apart from suppressing weeds, mulching reduced weed competition with the crop, conserved soil moisture and reduced soil temperature. These effects favoured the growth of the crop which in turn increased crop biomass and thus, the yield. High ground cover and crop biomass weight attributed to increased tuber weight. The control (no weeding) treatment for both varieties had the lowest crop biomass, dry matter and also the lowest yield in both sites resulting from high weed competition that affected crop growth.

Treatments positively affected weed density and biomass both at Muguga and Siaya where very high significant ($P< 0.001$) differences in their weights were observed for varieties SPK 004 and Kemb 10 grown at Muguga. Application of a pre-emergent herbicide recorded the least weight in weed biomass and dry matter, followed by where mulching was done (Fig. 5). Use of pre-emergent herbicide did not give higher yields than weeding twice and mulching options but can be useful where labor is a challenge.

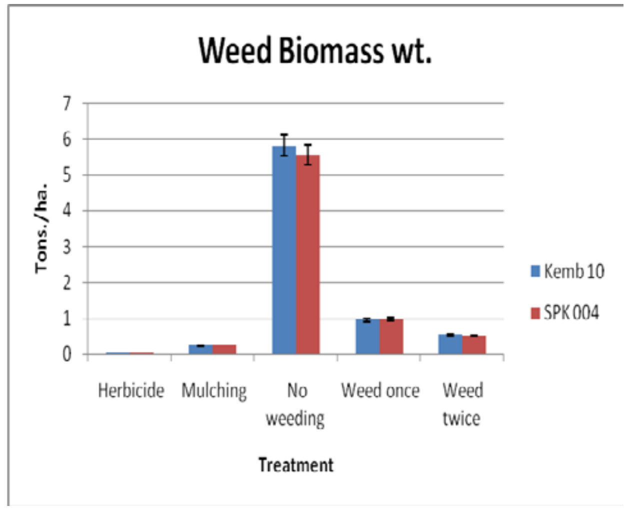

Fig. 5: Weed biomass weight of trials at Muguga

Similarly, Cuny-Kibuonjo and Bungoma varieties recorded very high significant ($P< 0.001$) differences in their weights while herbicide application recorded the least weights followed by mulching (Fig.6).

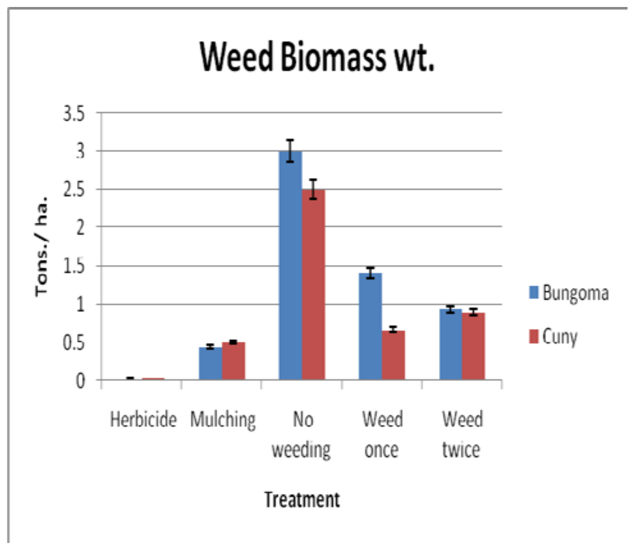

Fig. 6: Weed biomass weight of trials at Siaya

Mulching, application of a Pre-emergent herbicide, weeding twice and once somehow equally controlled weeds. This is reflected in less weed biomass weights as compared to the control treatment (Fig. 5, Fig. 6).

4. Conclusions

Although best weed control in the trials was achieved where a pre-emergent herbicide was applied followed by where mulching was done, the highest yield was obtained in weeded (KALRO-Muguga South) and in mulched plots at Siaya ATC. Effective weed control in sweet potatoes is necessary for the farmer to have increased tuber weight. Integrated weed management (IWM) approach such as mechanical, cultural, mulching and use of herbicides can be practiced where necessary and applicable to effectively control weeds during early stages of growth when the growth of the crop is low and weed competition high, in order to enhance production. Use of glyphosate herbicide 2-4 weeks before planting is effective where difficult to control *Digitaria abbysinica* (Couch grass) is dominant and manual weeding or ploughing using hoes or machetes cannot effectively control it.

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