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# WEED CONTROL EFFECTIVENESS OF COVER CROPS AND WEEDING REGIMES IN MAIZE (*Zea mays L.*)

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## ABSTRACT

The effectiveness of cover crops in controlling weed infestation varies with variety and weed intensity. The weed control effectiveness of three cover crops: sweet potato, forage cowpea and mucuna were investigated between 2009 and 2012 in a split plot arrangement of a randomized complete block design with four replications. Main plot was weeding regimes of once at 3 weeks after planting and twice at 3 and 6 weeks after planting. Cropping systems of sole crops and maize intercropped with cover crops were the sub-plots. Field experiments were conducted at Ilora Outstation of the Institute of Agricultural Research and Training, Moor Plantation, Ibadan. The cover crops were introduced two weeks after maize was sown. Generally the intercrops had reduced weed biomass relative to sole crops. A progressive weed biomass reduction was observed from 2009 to 2012. The intercrops in one and two weeding regimes maintained a similar trend where weed biomass from maize + cowpea > maize + sweet potato > maize + mucuna. Maize yielded higher in response to two weedings as observed in sole maize (1879.8 kg/ha) and maize + sweet potato intercrop (1690.5 kg/ha) during 2009 cropping season. The associated crops in the intercrops responded better to a second weeding than the maize crop. Sole sweet potato yield was 67% higher with one weeding and 82% higher with two weeding regimes than its yield from the intercrop. Yields from the sole crops were higher than the intercrops, irrespective of the weeding regime. Sweet potato spreads rapidly, covering the ground and suppressing weeds as well as providing additional income for the farmer. A good option of managing weeds effectively in maize cropping is sweet potato intercropping and two weeding regimes at 3 and 6 weeks after sowing.

**Keywords**: Maize; Weed intensity; weeding frequency; biological control; efficiency

## INTRODUCTION

Maize is an important subsistence crop in Nigeria with an annual grain production of approximately 11.05 million metric tons (FAO, 2023). The crop productivity is however significantly reduced by weed competition for resources like water, nutrients and light (Zimdahl, 2018). Manual weeding is still a major aspect of crop production for resource-poor farmers who cultivate maize on an extensive scale in Nigeria. According to Ogwuike *et al.* (2014), between 173 and 376 labour hours per hectare are needed for weed control in the traditional cultivation systems while in the industrial countries, it is estimated that less than one hour per hectare is needed for the chemical elimination of weeds. The time spent on weeding in traditional cultivation systems of the tropics on the average is about 40% of the working time of farm families (Anon, 1995). Therefore the future expansion of areas under cul-

tivation is contingent upon the appropriate cultural measures that would reduce the use of labour for weeding and improve output per unit land area.

High costs of herbicides have made chemical weed control unaffordable to the peasant farmers. An alternative to use of herbicides is the use of low-growing crops between the crop rows (Akinyemi and Makinde 1999; Chikoye *et al.* 2004). This has the advantage of low cash input. It also suppresses weeds without adversely affecting crop growth, protects the soil from erosion, improves soil physical properties and reduces the frequency of weeding carried out in maize. Awiti *et al.* (2000) reported that aggressive cover crops such as *Mucuna pruriens* and *Canavalia ensiformis* form dense mat of vegetation to cut-off sunlight from weeds physically by smothering.

Velvet bean (*Mucuna* spp) is a widely used cover crop in various cropping systems (Buckles *et al.*, 1998; Akobundu *et al.*, 2000; Chikoye *et al.*, 2001). It is a vigorous climbing annual legume. Velvet bean was introduced as one of the possible low-input technologies to enrich the soil and smother noxious weeds such as *Imperata cylindrica* (Akobundu *et al.*, 2000; Chikoye *et al.*, 2001). Mucuna is usually relayed into maize about five weeks after sowing as earlier planting provokes smothering of the young maize plants by the aggressively developing Mucuna, resulting in serious yield losses.

Sweet potato is a major food and industrial tuber crop in Nigeria with an estimated annual production figures of 4.08 million metric tons and average yield of 15 t/ha (FAO, 2023). Its tubers are edible by both man and livestock and the foliage also serves as feed stuff. Sweet potato is a planophile which does not develop sufficient vines and foliage within 30-40 days after planting. It is usually relayed into cassava or maize to smother annual weeds (Akobundu, 1987). The use of sweet potato and egusi melon has been reported to be effective in suppressing weeds in intercropping systems (Wahua, 1985; Akobundu, 1991; Olorunmaiye and Ogunleti, 2017). Sweet potato controlled weeds better than egusi melon when intercropped with plantain (Akinyemi and Makinde, 1999).

Cowpea (*Vigna unguiculata* [L.] Walp.) is a grain legume grown in the savanna regions of the tropics and subtropics. It was estimated that Nigeria produced 2.6 million tonnes of the 3.3 million tonnes of cowpea grains produced worldwide in 2000 (FAO, 2001). Traditionally, cowpea is grown on small farms and often intercropped with cereals such as maize (Kermah *et al.* 2018) to suppress weeds and increase soil nitrogen which improves cereal growth. Okoh *et al.* (2004) reported that early ground coverage by cowpea was poor due to slow growth during plant establishment.

This research was carried out to determine the effectiveness of three cover crops: sweet potato, forage cowpea and mucuna for weed management in maize.

## MATERIALS AND METHODS

### Experimental Location

The weed control effectiveness of cover crops and weeding regimes was investigated in field experiments conducted at Ilora Substation of the Institute of Agricultural Research and Training (IAR&T), Moor Plantation, Ibadan, during the cropping seasons (April – July) of 2009 to 2012.

**Soil Type**

The soil of the experimental site is Arenic Kandustalf (USDA 1994). It had a pH of 6.2. Organic C content was 0.56%; with a total nitrogen of 0.06%. The soil had 85% sand, 10% silt and 5% clay (Table 1).

**Table 1:** Soil properties of the experimental site.

| Property | Values |
|---|---|
| pH (in H20) | 6.2 |
| Texture (%) | |
| Sand | 85 |
| Silt | 10 |
| Clay | 5 |
| Organic carbon (%) | 0.56 |
| Total nitrogen (%) | 0.06 |
| CEC | 3.31 |

**Experimental Basics**

The experimental design was a randomized complete block with a split plot arrangement and four replications. The main treatments were weeding once at 3 weeks after planting and weeding twice at 3 and 6 weeks after planting. The sub-treatments were: sole maize, sole sweet potato, sole mucuna, sole cowpea, maize + sweet potato, maize + mucuna, and maize + cowpea. Main plot size of 50.0 m by 8.0 m was divided into seven sub-plots of 8.0 m by 6.0 m with inter - and intra-row distance of 1.0 m. Land preparation was by disk plowing and harrowing. Crop establishment was in mid-May…. each year.

The crop varieties used were maize - DMR-LSR-Y, sweet potato - TIS 2498, forage cowpea - IT81D-993 and *Mucuna cochinchinensis*. Maize was sown at 75 cm by 25 cm for a population of 55,555 plants/ha. The cover crops, (i.e. sweet potato, mucuna and cowpea) were relayed between the maize rows at a planting distance of 1.0 m by 0.5 m to give a population of 20,000 plants/ha. Cover crops were introduced into maize at three weeks after sowing (WAS). Manual weeding was carried out at 3 WAS in the main plots assigned to one weeding and at 3 and 6 WAS in those assigned to two weedings. N.P.K fertilizer was applied at 2-3 WAS and urea as top dressing according to the Institute of Agricultural Research and Training (IAR&T) recommendations.

Harvesting of Cowpea was in July between 8 and 10 WAS; Maize was harvested in August at 14 WAS; Mucuna was harvested between August and September between 12 and 16 WAS; Sweet potato harvesting was in September at 17 WAS.

**Data collection**

Weed biomass was obtained using a 1 m x 1 m quadrat at maize harvest. These were dried and weighed. The cover crops were harvested at maturity. Data were subjected to Analysis of Variance (ANOVA). Treatment means were compared at P = 0.05 using SE±.

## RESULTS

### Rainfall

There was more rainfall during the 2009 cropping season than other cropping seasons of the experiment, with the peak in June and the lowest in August (Table 2). In 2010, rainfalls during the growth period were lower than the previous year, 2009, with the peak also in June, and lowest in May. In 2011, total rainfall during the growing period was more than the previous year 2010 with same trend of peak in June but the lowest in July. Year 2012 had the lowest total rainfall during the growth period, with the peak in July and the lowest in May (Table 2).

### Weed biomass

The initial predominant weeds on the experimental site were guinea grass (*Panicum maximum* L.) and Mexican sunflower (*Tithonia diversifolia* L.). There was a progressive weed biomass reduction from 2009 to 2012 cropping seasons (Table 3).

In 2009 cropping season, weed biomass from the various sole crops and intercrops were comparable with one weeding regime (Table 3). Sole maize treatment produced weed biomass that was significantly higher than those from all other treatments when weeded twice. Weeding twice reduced the weed biomass from the intercrops by 44.6%, 69.0% and 76.4% in maize + mucuna, maize + sweet potato and maize + cowpea intercrops respectively, than sole maize.

Weed biomass in 2010 cropping season showed no significant differences between sole maize and the intercrops in plots both weeded once and twice (Table 3). However, maize + mucuna exhibited reduced weed pressure in both weeding regimes, averaged 80.9 $gm^{-2}$, compared with other treatments. There were significant differences between sole and intercropped mucuna in one weeding plots, whereas in plots weeded twice, sole and intercropped sweet potato and sole and intercropped cowpea exhibited these differences. The intercrops reduced weed biomass by 16.2% in sweet potato and 44.7% in mucuna when compared to the sole crops.

**Table 2:** Total monthly rainfall (mm) recorded at Ilora during 2009 to 2012.

| **Month** | **2009** | **2010** | **2011** | **2012** |
|---|---|---|---|---|
| January | ___ | 6.0 | 14.7 | ___ |
| February | 79.0 | 0.0 | 0.0 | ___ |
| March | 69.1 | 42.0 | 68.1 | 27.7 |
| April | 144.0 | 91.0 | 91.9 | 121.6 |
| ***May** | **152.2** | **68.0** | **189.9** | **59.1** |
| ***June** | **323.0** | **219.2** | **191.1** | **155.3** |
| ***July** | **234.0** | **85.0** | **48.2** | **194.8** |
| ***August** | **132.0** | **179.1** | **64.5** | **136.4** |
| ***September** | **148.0** | **147.0** | **215.3** | **132.0** |
| October | 222.8 | 123.5 | 78.1 | 288.8 |
| November | 36.0 | 5.0 | 0.0 | 29.3 |
| December | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 1540.1 | 965.8 | 961.8 | 1145.0 |

*****Cropping growth period

**Table 3:** Effect of cover crops and weeding regimes on weed biomass (g/m²) 14 WAS

| Treatment | Weeding regimes 2009 | | Weeding regimes 2010 | | Weeding regimes 2012 | |
|---|---|---|---|---|---|---|
| | One weeding | Two weedings | One weeding | Two weed-ings | One weeding | Two weed-ings |
| Sweet potato | 302.8 | 261.7 | 85.3 | 208.9 | 60.2 | 44.1 |
| Maize + sweet potato | 251.6 | 103.9 | 112.9 | 87.5 | 46.2 | 47.2 |
| Mucuna | 220.4 | 176.9 | 147.7 | 90.8 | 54.4 | 52.1 |
| Maize + mucuna | 342.4 | 186.2 | 81.7 | 80.1 | 50.7 | 34.7 |
| Cowpea | 300.5 | 136.5 | 179.6 | 119.2 | 65.8 | 74.4 |
| Maize + cow-pea | 282.5 | 79.5 | 162.0 | 190.0 | 40.2 | 45.0 |
| Maize | 232.2 | 673.2 | 105.2 | 138.7 | 59.1 | 55.0 |
| SE± | **160.3** | | **31.2** | | 11.6 | |

During 2012 cropping season, no differences were observed between sole maize and the intercrops in plots both weeded once and twice with the exception of cowpea.

Cowpea intercrop reduced weeds significantly by 38.9% and 39.5% in one and two weeding regimes. Mucuna intercropped with maize appears to have lowest weed biomass during 2010 and 2012 cropping seasons. The intercrops with one and two weeding regimes maintained a similar trend where weed biomass from maize + cowpea > maize + sweet potato > maize + mucuna.

**Yield**

Maize yielded higher in response to two weedings as was observed in sole maize (1879.8 kg/ha) and maize + sweet potato intercrop (1690.5 kg/ha) during 2009 cropping season (Table 4). Yield from sole maize was significantly higher than yields from maize + mucuna and maize + cowpea intercrops. Maize yields in treatments weeded once were higher in sole maize than all the intercrops. Sole sweet potato and sole mucuna out-yielded their intercrops in 2009 cropping season, irrespective of the weeding regime. Sole sweet potato yield was 67% higher in one weeding and 82% higher in two weedings than its yield from the intercrop. Mucuna yield was 19.4% and 17.7% higher in one weeding and two weedings regimes, respectively. Cowpea recorded no grain yield for 2009.

Maize yields in both weeding regimes were similar during 2010 except that a second weeding significantly influence maize + mucuna intercrop (Table 5). Similarly, maize yield of sole maize was significantly higher than that of maize + mucuna intercrop.

In 2010, sole cover crops yielded more sweet potato, mucuna and cowpea than the intercrops (Table 5) and 2012 (Table 6). In the same manner, a second weeding generally influenced higher yields of the cover crops for both years. Maize yielded higher in the sole maize from one weeding and two weeding regimes (1545.5 and 1741.3 kg/ha, re-

**Table 4:** Effect of cover crops and weeding regimes on sole and intercrop yields (2009).

| Treatments | Weeding regimes | |
|---|---|---|
| | **One weeding (x1)** | **Two weedings (x2)** |
| | Maize grain yield (kg/ha) | |
| Maize (sole) | 1531.0 | 1879.8 |
| Maize + Sweet Potato | 1205.4 | 1690.5 |
| Maize + Mucuna | 1371.4 | 1178.6 |
| Maize + Cowpea | 1236.9 | 1381.0 |
| **SE±** | **200.9** | |
| | Sweet potato yield (kg/ha) | |
| Sweet potato (sole) | 946.4 | 3291.7 |
| Maize + Sweet Potato | 85.7 | 532.1 |
| **SE±** | **379.3** | |
| | Mucuna yield (kg/ha) | |
| Mucuna (sole) | 175.0 | 235.1 |
| Maize + Mucuna | 141.1 | 193.5 |
| **SE±** | **17.3** | |
| | Cowpea yield (kg/ha) | |
| Cowpea (sole) | ___ | ___ |
| Maize + Cowpea | ___ | ___ |

Table 5: Effect of cover crops and weeding regimes on sole and intercrop yields (2010).

| Treatments | Weeding regimes | |
|---|---|---|
| | **One weeding (x1)** | **Two weedings (x2)** |
| | Maize grain yield (kg/ha) | |
| Maize (sole) | 2307.7 | 2237.8 |
| Maize + Sweet Potato | 2028.0 | 1888.1 |
| Maize + Mucuna | 1118.9 | 1818.2 |
| Maize + Cowpea | 1958.0 | 1958.1 |
| **SE±** | **216.9** | |
| | Sweet potato yield (kg/ha) | |
| Sweet potato (sole) | 550.0 | 753.1 |
| Maize + Sweet Potato | 161.5 | 435.4 |
| **SE±** | **212.3** | |
| | Mucuna yield (kg/ha) | |
| Mucuna (sole) | 192.7 | 218.7 |
| Maize + Mucuna | 20.8 | 49.5 |
| **SE±** | **17.6** | |
| | Cowpea yield (kg/ha) | |
| Cowpea (sole) | 68.3 | 368.3 |
| Maize + Cowpea | 22.5 | 111.6 |
| **SE±** | **42.2** | |

spectively), than the intercrops, except for maize + sweet potato intercrop in one weed-

**Table 6:** Effect of cover crops and weeding regimes on sole and intercrop yields (2012).

| Treatments | Weeding regimes | |
|---|---|---|
| | **One weeding (x1)** | **Two weedings (x2)** |
| | Maize grain yield (kg/ha) | |
| Maize (sole) | 1545.5 | 1741.3 |
| Maize + Sweet Potato | 1516.4 | 1223.8 |
| Maize + Mucuna | 1104.9 | 1125.9 |
| Maize + Cowpea | 783.2 | 1363.6 |
| **SE±** | **197.8** | |
| | Sweet potato yield (kg/ha) | |
| Sweet potato (sole) | 1264.6 | 1395.8 |
| Maize + Sweet Potato | 588.5 | 588.5 |
| **SE±** | **63.6** | |
| | Mucuna yield (kg/ha) | |
| Mucuna (sole) | 253.1 | 130.2 |
| Maize + Mucuna | 211.4 | 250.0 |
| **SE±** | **29.5** | |
| | Cowpea yield (kg/ha) | |
| Cowpea (sole) | 132.5 | 250.0 |
| Maize + Cowpea | 81.7 | 94.2 |
| **SE±** | **33.0** | |

ing regime (Table 6). Two weeding regimes also produced higher maize yield than one weeding regime in maize + cowpea intercrop during 2012 (Table 6).

## DISCUSSION

Very low rainfall in the months of July and August 2011 led to stunted growth and poor yield of maize with no yields from the cover crops. Hence, the results of that year were not presented. The trend of rainfall during the growth period reflected on weed biomass. It was highest with rainfall in 2019 and lowest in 2012. This is an indication of general greater weed infestation with more rainfall. The timing and rainfall amount had been reported a determinant of weed infestation (Werth *et al*., 2017) After the harvest of maize, the cover crops (i.e. sweet potato, mucuna and cowpea), stayed on the field for additional four to twelve weeks before their maturity. Generally the intercrops had reduced weed biomass compared to the sole crops. This corroborates the findings of Eneji *et al.* (1995) that cover cropping reduced weed pressure. There were more weeds in sole maize plots due to less competition from a single crop. However, in intercrops with sweet potato, mucuna and cowpea, reduced weed biomass was due to more competition from the cover crops. Weed biomass from sole sweet potato, sole mucuna and their intercrops with maize indicated that a second weeding might not be necessary because weed biomass of one weeding regime was not different from two weeding regimes. Results from sole maize during 2009 and 2010, where higher weed biomass unexpectedly occurred in two weeding regimes, was due to the high incidence of Mexican sunflower on treatment plots (data not shown). No cover crop performed outstand-

ingly better than the other in keeping down the weed pressure on experimental plots. The dominant weeds of the experimental site, guinea grass and Mexican sunflower, were considerably suppressed after the four -year trial.

The difference exhibited in sole maize yields between one and two weedings in 2009 was not sustained in the other years of trial. This could be because of reduction in weed pressure resulting from effective control by the cover crops as indicated in the weed biomass of different years. Maize yields from the intercrops generally did not respond to a second weeding like the cover crop yields. This suggested that a second weeding might not be necessary for the major crop if grown in association with cover crops. Irrespective of weeding regime sole maize plot produced higher yield than maize intercrops. In another study, it was observed that cover crops reduced maize yield (Abdin et al., 2000). The expected difference between the sole and intercropped yields of maize was more pronounced in 2012 because there was less competition with weeds. In the first year, there was competition between the maize and the cover crops as well as the weeds. As the years progressed and weeds were suppressed through the effect of cover crops, much of the latter competition was with the cover crops.

## CONCLUSION

The use of cover crops progressively reduced the weed incidence and almost suppressed the initial weeds of importance on the experimental site. Cover crops provided additional weed control to the manual weeding regimes. The aggressive growth of mucuna and its ability to shade out weeds and reduce weed biomass makes it desirable. Due to the fact that the seeds cannot provide additional income to the farmer, this makes its adoption improbable. Therefore sweet potato is a better option for intercrop in maize with two weeding regimes.

## REFERENCES

**Abdin, O. A., X. M. Zhou, D. Cloutier, D. C. Coulman, M. A. Faris, D. L. Smith** 2000. Cover crops and interrow tillage for weed control in short season maize (*Zea mays*). *European Journal of Agronomy* 12: 93–102.

**Akinyemi, S. O. S. and J. O. Makinde.** 1999. Effect of sweet potato and melon intercrop on weed interference and productivity of plantain. *Nigerian Journal of Weed Science* 12: 29-34.

**Akobundu, I. O.** 1987. Weed science in the tropics: principles and practices. John Wiley and Sons Limited, New York. 522 pp.

**Akobundu, I. O.** 1991. Weed management in tropical cropping systems. *Tropical Pest Management* 37 (2): 123-130.

**Akobundu, I. O., U. E. Udensi and D. Chikoye.** 2000. Velvetbean (*Mucuna* spp.) suppresses speargrass (*Imperata cylindrica* [L.] Raeuschel) and increases maize yield. *International Journal of Pest Management* 46: 103-108.

**Anonymous**. 1995. Weeding with weeds while restoring soil fertility. CGIAR News 2: 3-4.

**Awiti, S., K. Binney, M. K. Chan, N. O'Connell, D. Jackson, E. Kiff and D. Nelson.** 2000. Improved vegetable production in the forest-savanna transition zone of Ghana. *Acta Horticulturae* 513: 213-220.

**Buckles, D., B. Triomphe and G. Sain.** 1998. Cover crops in hillside agriculture:

farmer innovation with mucuna. International Maize and Wheat Improvement Center; International Development Research Centre, Ottawa, Canada. 218pp.

**Chikoye, D. and F. Ekeleme** 2001. Weed flora in maize production systems in Nigeria. *Weed Research* 41 (3): 249-259.

**Chikoye, D., F. Ekeleme and E. U. Udensi.** 2001. Congograss suppression by intercropping cover crops in corn/cassava systems. *Weed Science* 49: 658-667.

**Chikoye, D., F. Ekeleme and G. Gbehounou.** 2004.Suppression of speargrass (*Imperata cylindrica*) in maize using sweet potato and two leguminous cover crops. *Nigerian Journal of Weed Science* 17: 35-42.

**Eneji, A. E., A. A. Agboola and O. Isholla.** 1995. The weed suppressive ability of sweet potato in a cassava+ maize +sweet potato intercrop. *Nigerian Journal of Weed Science* 12: 13-18.

**FAO** 2023. Food and Agriculture Organization. Production data of sweet potato in Nigeria.

**Kermah M., A. C. Franke, S. Adjeinsiah, B. D. K. Ahiabor, R. C. Abaidoo, and**
**K. E. Giller** 2018. $N_2$-fixation and N contribution by grain legumes under different soil fertility status and cropping systems in the Guinea savanna of northern Ghana. *Agriculture Ecosystem and Environment* 261: 201 -210

**Ogwuike P., J. Rodenburg, and A. Diagne** 2014. Weed management in upland rice in sub-Saharan Africa: impact on labor and crop productivity. *Food Security* 6: 327-337

**Olorunmaiye, P. M. and D. O. Ogunleti** 2017. Effects of egusi melon (*Citrullus lanatus*) and sweet potato (*Ipomoea batatas*) intercrop on weed suppression and yield. *Journal of Agricultural Science* 9 (8): 191-198.

**Okoh, K. A., J. A. Oladiran and M. G. M. Kolo**. 2004. Evaluation of the weed suppressive efficiency and productivity of cowpea varieties. *Nigerian Journal of Weed Science* 17: 15-19.

**USDA** 1994. Keys to soil taxonomy. Soil Conservation Service. United States Department of Agriculture. Sixth edition.

**Wahua, T. A. T.** 1985. Effect of melon (*Colocynthis vulgaris*) population density on intercropped maize (Zea mays) and melon. *Experimental Agriculture* 21: 281-289.

**Werth, J.F., Keenan, M., Thorny, D., Bell, K and S. Walker** 2017. Emergence of four weed species in response to rainfall and temperature. *Weed Biology and Management* 17 (1): 29 -35.

**Zimdahl, R. A.** 2018. Weed-crop competition: a review. Wiley Publishers. 211 pp.

**Lawson I. Y. D., I. K. Dzomeku, R. Asempa and S. Benson.** 2006. Weed control in maize using Mucuna and Canavalia as intercrops in the Northern Guinea savanna zone of Ghana. *Journal of Agronomy* 5 (4): 621-625.

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