

Effect of Poultry manure rates and vine staking on the incidence and severity of *Cylas puncticolis* (Curculionidae: Brentidae) on sweet potato (*Ipomea batatas* Lam).

By

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Poultry manure rates and vine lifting were evaluated for their effects on yield of sweet potato and incidence of the potato weevil (*Cylas puncticolis*) during the 2008 and 2009 cropping season in Samaru, Zaria, Nigeria. Five rates of poultry manure (0, 5, 10, 15 and 20 tons/ha) and a recommended fertilizer rate was used as check. The poultry manure was applied by drilling the ridges and applying the manure and covering them back with soil while the fertilizer was applied soon after sprouting by drilling. Vine lifting was done five weeks after planting when the vines started crawling on the ground by staking with pegs. The experiment was laid out in a Randomized Complete Block Design (RCBD). The result showed that at 5 Weeks After Planting (WAP), the poultry manure rate of 5 tons/ha had a significantly higher *Cylas puncticolis* population than all other manure rates including the fertilizer. At 8 WAP the 15 tons/ha had a significantly higher insect population than all other manure rates. Vine lifting had no effect on the insect population. There was no significant difference between the sweet potato yield of the fertilizer and 5 tons/ha treated plots which were significantly higher than all other manure rates. Vine lifting had a significantly higher yield and high insect incidence than the non-vine lifted plots.

Keywords: Manure rates, vine lifting, *Cylas puncticolis*, sweet potato, tuber weight, emergence holes.

Introduction:

Sweet potato (*Ipomea batatas* L.) is known to be of South American origin and was introduced into Africa and Asia by Europeans. The crop is mainly grown for subsistence purposes and of the estimated world production of 107 million metric tons in 1980; Asia produced 98 million tons and Africa only 6 million tons and the remaining 3 million tons were produced from other parts of the world (Gibbon and Pain, 1988).

The sweet potato tuber is used for food in many countries. It is eaten boiled, fried, baked or made into syrup and also serves as raw material for the manufacture of starch, glucose and alcohol. The leaves are used as vegetable in some communities while the crop residues can be used as livestock feed. The tubers can be sliced and sun-dried for storage (Gibbon and Pain, 1985).

The African sweet potato weevil (*Cylas puncticolis*) is one of the most important pests of sweet potato in tropical Africa, notably, Uganda, Rwanda, Kenya, Cameroon and Nigeria. *Cylas brunneus* is known from west and central Africa and some countries in east Africa (Hill, 1983). Adult weevils feed on leaves, the underground storage roots (tubers) and the vines of sweet potato. They prefer to feed on storage roots, but at the beginning of the growing

season when the plants have not yet produce storage roots, the adult weevils live on the stem and leaves. They lay eggs on vines and leaves and the grubs will feed on the stem or leaves and pupate. Stem damage is believed to be the main reason for yield loss, although damage to the vascular system caused by feeding, larval tunneling and secondary rots reduces the size and number of roots. As the plant gets older and starts to form storage roots, the weevils search for exposed roots. Since they cannot dig, they reach the tubers through cracks on the soil (Bamaiyi *et al.* 2007). Sweet potato responds well to farmyard manure or compost because it increases the nitrogen content of the soil. Application of poultry manure can enhance sweet potato tuber yield by 3.6-7.2 tons/ha. Poultry manure enhances soil microbial activities which enhance nutrient supply (Udoh *et al.*, 2005).

Vine lifting or vine staking during the vegetative growth phase prevents stem rooting, the development round the plant's outer edges of smaller tuberous root that lower the crop's yield and divert nutrients away from the central tuberous roots. Vine lifting also helps in reducing the level of pests and diseases attack on the tubers of sweet potato (Degras, 2003).

Many sweet potato varieties are characterized by a growth habit of long vines creeping over the soil surface. If the

soil is moist and the stem touches it, root nodes develop into tubers which are usually small and not marketable. This waste is prevented by lifting the vines so that any roots growing at the nodes break or dry out (Rasco and Amante, 2000).

Sweet potato is grown mainly to supplement the demands for yam as an alternative energy giving food. The savanna ecological zone of Nigeria where the crop is mostly grown gives very low yield. This low yield is usually significantly increased with application of inorganic fertilizers, but these are usually not affordable due to their high costs. Poultry manure is available in Nigeria which could supplement the inorganic fertilizers. Thus, this work was carried out to investigate the effect of poultry manure and vine lifting on the incidence and severity of damage on sweet potato tuber yield as affected by *Cylas puncticolis*.

Materials and Methods

The trials were carried out during the 2008 and 2009 cropping seasons at the Samaru College of Agriculture Students' demonstration farm, Samaru, Zaria, located in the northern Guinea savanna ecological zone of Nigeria 11°10'N and 7°38'E, 686 meter above sea level. The trials consisted of five levels of poultry manure as follows: 0 t/ha; 5 t/ha; 10 t/ha; 15 t/ha; 20 t/ha and a recommended fertilizer rate as a check. This is usually applied in the form of NPK compound fertilizers with a high K content (50:50:127.5 Kg a.i. NPK/ha. NPK 15:15:15 was used at the rate of 50 KgN/ha, 50 KgP₂O₅/ha and 120 KgK₂O/ha and the remaining of the K₂O was supplemented by muriate of potash (70 Kg K₂O/ha) (Udoh *et al.*, 2005). Vine lifting was also compared with non-vine lifting. The treatments were laid out in a randomized complete block design (RCBD) in three replicates. Each replicate had ten plots, with each gross plot size of 4m x 4m (16m²) and a net plot of 9m².

The land was ploughed, harrowed and ridged at 75 cm (inter-row spacing) and an intra-row spacing of 40 cm and marked out according to the plan of the experiments. The vine cuttings were planted by hand with one vine stick per hole at 40cm (spacing intra- row).

The application of organic manure was carried out two weeks before the potato vine cuttings were transplanted into the field. This was done manually with hoe and covered with the soil. This practice was adopted to prevent toxic substances and heat released during the decomposition of poultry manure from injuring the transplanted vines. Potato is generally transplanted from vine cuttings by farmers in Nigeria and most of Africa (Talekar, 1991; Youdeowei, 2002).

Manual hoe weeding was done at two weeks after planting and then hand pulling of the weeds was also done at six weeks after planting. The fast spreading of

branches and leaves of the crops suppressed and smothered further weed growth.

Vine lifting was done five weeks after the planting when the vines started crawling on the ground. The vine lifting was done using pegs in accordance with the experimental specifications (Udoh, *et al.* 2005, Talekar, 1991; Youdeowei, 2002).

The following parameters formed the data collected in field:

1. *Cylas puncticolis* damage score
2. Number of tubers per plot with emergence holes
3. Number of emergence holes per tuber
4. Tuber weight/m²

The data was subjected to ANOVA to test the significant effect of the treatment using F-test. The Duncan's New Multiple Range Test was used to compare statistically significant means of the treatments. The two years data was pooled and only the mean is reported in this work.

Result and Discussion.

The effect of poultry manure rates and vine lifting of sweet potato on the activities of *Cylas puncticolis* per plot is shown on Table 1. At 5 WAP manure rate of 5 tons/ha had a significantly higher incidence and severity of *Cylas puncticolis* per plot than the other manure rates. The inorganic fertilizers had the lowest pest infestation.

There was no significant difference in the number of pests per plot in both vine lifted and non-vine lifted irrespective of the period of crop sampling.

This result is expected because poultry manure and vine lifting have been reported to induce rapid growth and reduce pest and disease incidence (Degras, 2003, Grandy *et al.*, 2002; Edmond and Ammerman, 1971).

Data on manure rate and vine lifting of sweet potato leaves on pests' damage score is shown on Table 2. The result showed an increase in pest damage with increase in crop age. The manure rate of 5 tons and 10 tons/ha showed a significant effect on pest damage score as these rates had no effect on the pest damage. The 5 tons and 10 tons/ha manure rates stimulated rapid vegetative growth which made the plants look attractive and succulent to the insects.

Vine lifting had no effect on pest damage at the earlier stage of growth but at 9 and 12 WAP, the vine lifted plots suffered significantly higher pest damage than non-vine lifted plots. This result agrees with Degras (2003) who reported that vine lifting or turning during vegetative growth phase expose potato vines to pest attack.

The effect of manure rates on yield and yield components of sweet potato is shown Table 3. Recommended Fertilizer Rate (FR) and 5 tons/ha manure rate gave the highest tuber weight per plot (10.97 kg and 10.48). The zero t/ha manure rate/level was even better than 15 t/ha and 20 t/ha of manure. Thus, increasing manure rate above 20 t/ha does not increase tuber

weights. There was no significant difference in the number of tubers per plot in all the treatments except the 20 t/ha manure treated plot, which was lower than all the treatments even the zero t/ha. This result is in agreement with Udoh *et. al.*, (2005) who reported that the recommended rate of nitrogen and potassium will produce optimum tuber yield of sweet potato.

There was no significant difference in the yield of the vine lifted and the non-lifted vines. This result agrees with Duvull (1982) who reported that lifted or non-lifted vines do not increase the growth or yield of the crop irrespective of the period of sampling.

The number of emergence holes per tuber (damage severity) and number of tubers with emergence holes (damage incidence) were significantly reduced by the recommended fertilizer rate treatment but highest in the treatment with 15 t/ha. The zero ton/ha had the highest emergence holes per tuber (10.75) followed by 15 tons/ha with emergence holes of (9.75) per tuber. Treatment with manure rate at 15 tons/ha significantly produced the highest number of tubers with emergence holes, followed by 5 tons/ha. Soils rich in organic matter or manure improves the infiltration rate, water holding capacity and soil structure making the soil particle soft and loose (Grandy *et al.*, 2002). This makes the soil more porous, thus, making it easy for the penetration of both adults and larvae of *Cylas puncticolis* and *Cylas formicarius* cause the major damages on the sweet potato tubers.

The recommended fertilizer rate gave the lowest number of tubers with emergence holes and also the lowest number of emergence holes per tuber. This is because inorganic fertilizers have been reported to cause hardening caking in some soils, thus, making the soil harder for adult and larvae to penetrate the soil to attack the sweet potato tuber (Dunguni, 1998; Pfeiffer, 1982; PPRSD, 2000; Smit and Matengo, 1995). The yield of the vine lifted plots, though not significantly different from the non-vine lifted plots, were better than the manure rates of 10, 15 and 20 tons/ha. This is because the vine lifted crops prevent sprouting of roots at the nodes, thus, channeling all the nutrients and manufacture food to the main tubers, which in turn increased yields of the crop. When vines are not lifted, root sprouting at nodes will have water and nutrients supplied to those roots which would be wasted. This will reduce the yield of marketable roots. This waste is prevented by vine lifting so that any roots growing at the nodes break or dry out. Thus, manure rates of 5 and 10 t/ha are ideal for optimum yield of sweet potato and vine. However, these rates do not significantly improve the yield of sweet potato but reduces the incidence of *Cylas puncticolis*. This result agrees with other workers who found the application of poultry manure to vine lifted sweet potato induces significant higher yields (Rasco and Amante, 2000; Van de Fliet and Braun, 1999).

Table 1: Effect of manure rate and vine lifting on the incidence of *Cylas puncticolis* on sweet potato

Manure rate (tons/ha)	5 WAP	6 WAP	7 WAP	8 WAP	9 WAP	10 WAP	11 WAP	12 WAP
0	4.0bc	4.7	4.5b	6.5bc	8.3	5.7	10.8	10.8
5	6.3a	6.0	6.0ab	6.5bc	8.7	6.7	10.5	8.7
10	5.8ab	6.5	7.7ab	7.8ab	8.5	7.3	10.2	10.8
15	5.2ab	5.2	8.2a	9.7a	7.3	7.8	8.5	9.3
20	4.3bc	5.3	5.7ab	6.2bc	8.2	6.7	7.7	10.2
*FR	2.5c	4.5	6.8ab	4.8c	6.8	7.0	9.7	8.8
SE ±	0.67	0.82	0.94	0.74	0.85	0.86	0.96	0.92
Vine lifting								
V1	5.2	5.6	6.7	7.1	8.3	7.1	10.2	10.2
V2	4.2	5.2	6.2	6.8	7.7	6.7	8.9	9.3
SE ±	0.67	0.82	0.94	0.74	0.85	0.86	0.96	0.92

Means within a column followed by the same letter(s) are not significantly different at 5% using New Duncan Multiple Range Test

WAP = Weeks After Planting of vine cuttings

*FR = Recommended Fertilizer Rates

V1 = Vine lifting

V2 = Non-vine lifting

Table 2: Effect of manure rate and vine lifting on the damage by *Cylas puncticolis* on sweet potato.

Manure rate (tons/ha)	5 WAP	6 WAP	7 WAP	8 WAP	9 WAP	10 WAP	11 WAP	12 WAP
0	0.35bc	0.85c	1.50c	2.45bc	3.38bc	5.97ab	6.70abc	8.00b
5	0.85a	1.37abc	2.23ab	2.92b	4.20ab	6.17a	7.65a	9.33a
10	0.65ab	1.63a	2.38ab	3.58a	4.43a	6.53a	7.30ab	8.08b
15	0.43bc	1.42ab	2.23ab	2.90b	4.08ab	5.90ab	6.35bc	7.00b
20	0.42bc	0.98bc	1.62bc	2.42bc	3.42bc	4.48c	6.17bc	7.72b
*FR	0.23c	1.02bc	1.47c	2.30c	2.93c	4.90bc	5.82c	7.17b
SE ±	0.320	0.370	0.400	0.380	0.220	0.530	0.540	0.580

Table 2 continues.

Vine lifting								
V1	0.54	1.32	1.94	2.88	4.08a	5.87	6.77	8.29a
V2	0.43	1.10	1.87	2.64	3.40b	5.44	6.56	7.47b
SE ±	0.320	0.370	0.400	0.380	0.220	0.530	0.540	0.580

Means within a column followed by the same letter(s) are not significantly different at 5% using New Duncan Multiple Range Test

WAP =Weeks After Planting of vine cuttings

*FR = Recommended Fertilizer Rates

V1 = Vine lifting

V2 = Non-vine lifting

Table 3: Effect of manure rates and vine lifting on the yield and incidence of *Cylas puncticolis* on sweet potato

Manure rate(tons/ha)	Tuber wt./m ²	No. of emergence holes/tuber	No. of tubers with holes	Tuber number/plot
0	7.1c	10.8a	2.6abc	42.0c
5	10.5a	7.3abc	3.3ab	49.3a
10	7.5bc	4.0bc	1.0c	49.5a
15	6.7c	9.8a	4.0a	41.5c
20	4.1c	6.8abc	2.5abc	32.0d
*FR	10.9a	3.3c	1.9bc	47.3b
SE±	0.67	1.24	0.69	1.59
Vine lifting				
V1	8.32	9.7a	3.2a	44.4
V2	7.3	4.3b	2.0b	42.9
SE ±	0.67	1.24	0.69	1.59

Means within the same column followed by the same letter(s) are not significantly different using New Duncan Multiple Range Test (NDMRT) at 5% level of probability.

WAP =Weeks After Planting of vine cuttings

*FR = Recommended Fertilizer Rates

V1 = Vine lifting

V2 = Non-vine lifting

References

Bamaiyi, L.J.; Dauji, L.Z. and Wamagi, I.T. 2007: Effect of cultural practices of sweet potato (*Ipomoea batatas* Lam.) on population of sweet potato weevil (*Cylas puncticolis* Bohaman) in the northern guinea savanna of Nigeria. Proceedings of the 41st Conference of the Agricultural Society of Nigeria, held at the Institute for Agricultural Research, Ahmadu Bello University, Zaria, 22-26 October, 2007.

Degras, L. 2003: The tropical Agriculturist. Revised by Don Tindall and Zhang Dapena. Macmillan Publishers Ltd. 59p.

Dunguni, S. M. 1998: Farmers' Field School, Kilifi, Kenya

Duvull, J. O. 1982: Farmer field school for integrated crop management of sweet potato. Field Guides and Technical Manual. International Potato Centre, Lima, Peru, pp.98.

Edmond, J.B. and Ammerman, O. 1971: Sweet potatoes: Production, Processing and Marketing. Major feed

and food crops in agriculture and food series. The AVI Publishing Company, Inc., Westport, Connecticut, pp.113-114.

Gibbon, D. and Pain, A. 1985: Crops of the drier regions of the tropics. Longman Group, UK Ltd, pp.135-136.

Grandy, A.S., Porter, G.A. and Erich, M.S. 2002: Organic amendment and rotation crop effects on the recovery of soil organic matter and aggregation in potato cropping systems. *Soil Science Society of American Journal* 66:1311-1319.

Hills, D. 1983: Agricultural insect pests of the tropics and their control. 2nd edition, Cambridge University Press.

Peterson, J.K.; Harrison, H.F. Jr and Snook, M.E. 1999: Comparison of three parameters for estimation of allelopathic

potential in sweet potato (*Ipomoea batatas* (L.) Lam.) germplasm. *Allelopathy Journal* 6: 201-208.

Pfeiffer H.J. 1982: Sweet-potato improvement in Cameroon. Root crops in eastern Africa. Proceedings of a workshop held at Kigali, Rwanda, 23-27 November 1980, 33-38.

Plant Protection and Regulatory Services Directorate (PPRSD) 2000: Handbook of crop protection recommendations in Ghana: An IPM approach. Vol. 3: Root and Tuber Crops,

Plantains. E. Blay, A.R. Cudjoe and M. Braun (editors). Published by PPRSD with support of the German Development Cooperation (GTZ).

Rasco, E.T and Amante, V. 2000: Sweet potato in tropical Asia. Apprad-Pcarro, 230pp.

Smit, N.E.J.M and Matengo L.O. 1995: Farmers' cultural practices and their effects on pest control in sweet potato in

south Nyanza, Kenya. *International Journal of Pest Management*, 41 (1): 2-7.

Talekar, N.S. 1991: Integrated control of *Cylas formicarius*. In sweet potato Pest Management: A global perspective. Jansson Kuraman. Eds. Westview Press. Pp. 139-156.

Udoh, D.J., Ndon, B.A., Asuquo, P.E. and Ndaeyo, N.U. 2005: Crop production techniques for the tropics, 201pp.

Van de Fliet, E. and Braun, A. 1999: Farmer field school for integrated crop management of sweet potato. Field Guides and Technical Manual. International Potato Centre, Lima, Peru, pp.266.

Youdeowei, A. 2002: Integrated Pest Management Practices for the Production of Root and Tubers and Plantains. IPM Extension Guide 3. Ministry of Food and Agriculture. Plant Protection and Regulatory Services Directorate (PPRSD), Ghana, with German Development Cooperation (GTZ).