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Survey of Potato aphid (*Myzus persicae*) from Selected on-farm Potato growing Areas in Mbeya and Njombe regions of Tanzania

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Abstract

Potato aphid green peach (*Myzus persicae* Sulzer) is one of the serious pests in potato (*Solanum tuberosum*) production areas in the world. A survey was carried out during 2014 potato growing season to assess aphid and Coccinellid population abundance in potato production areas in Mbeya and Njombe regions situated in southern highlands of Tanzania. Aphid and Coccinellid abundance were sampled from 30 leaves selected randomly from ten plants. Estimates of aphid abundance from potato fields were carried out from transectline replicated three times. A total of 1,370 aphid populations were sampled during the survey period. Abundance from young leaves was 898, followed by medium leaves 270 and the least was old leaves represented by 202 individuals. The relative abundance of aphid population resulted from 15 minutes sampling effort per transect ranked from 8 individuals from Swaya village to 171 individuals from Atwelo village and the rest were in between. The differences between selected plant parts showed significant differences ($p = 0.001$). The results from this survey provides database on aphid population and Coccinellid natural enemies of potato aphid in potato growing areas which can be used for future research in the selected regions.

Key words: *Myzus persicae*, potato aphid, Coccinellid

1. Introduction

Potato green peach aphid (*Myzus persicae*) is considered as one of the serious pests in potato production areas. Green peach aphids affect potato seed sector by feeding on the plants as well as planting materials and transmits virus diseases (Hooker, 1986). The green peach aphid is distributed worldwide and infest over 400 species of plants (Cloyd *et al*., 1998). Nymphs and adults are capable to transmit disease but adults are more capable to transmit plant diseases since they are able to migrate from one plant to another (Flanders *et al.,* 1991). The aphid's mouthparts, which are stylet-like, penetrate the leaf tissue reaching the phloem and sucking the plant sap (Goodfrey, 1997). Aphid control in most cases rely on application of insecticides but potato aphid has different natural enemies including ladybugs or ladybird beetles and lacewing that can reduce population of aphids below economic threshold levels (Bailey, 1993). Extensive application of insecticides may result into decrease of natural enemies and increase aphid population (Oetting, 1985; Rowe, 1993).

2. Materials and Methods

The selected surveyed sites

The survey was carried out in different potato growing areas in Mbeya and Njombe regions as summarized in Table 1. The surveyed areas ranged from 1,772M at Ulembwe to 2,248M at Luponde above sea level. The rest were located in areas characterized by hills, plains, varying soil types, and vegetation ground cover.

2.1 Aphid sampling

Fifteen potato fields were selected from each of Njombe and Mbeya regions where three transects per potato field were laid in between the borders of the surveyed areas. Transects were 10M away from each other. Sampling of phytophagous arthropods was carried out through suction sampling or hand sorting during morning hours and preserved in 70% ethanol for laboratory work. Visual inspection of Potato aphids population and other arthropods were estimated from ten plants per transect focusing on upper most leaves including young leaves,

flowers, middle leaves and lower leaves near to soil surfaces. A total of thirty leaves were randomly selected from ten potato plants for aphid population studies. Aphids and other arthropods were examined on the underside of the potato leaves and counted using hand counter (EPPO, 2005).Visual inspection of predator and aphid population were sampled from 8.00 am to 12 00 noon.

2.2 Tested organisms

Wingless aphids population were sampled and identified to the species level. Other arthropods were also sampled and their relative abundances estimated.

2.3 Agricultural practice

During the survey fungicides and insecticides were applied to few potato farms every after two weeks to protect late blight disease (*Pyhtopthrora infestans*) as well as aphids. Potato fields that were regularly sprayed with insecticides were also included in the aphid populating studies (Rowe, 1993).

2.4 Survey design

Three transects per potato field were established in each selected potato field (n=3; transects).
Transects selected were also used to sample other economic arthropods ie coccinellids. Transect were 10M away from each other to capture different physiological conditions. Aphids were randomly sampled by hand sorting while other insects including beetles were sampled by sucking method from young leaves, medium and lower leaves (old leaves). Sampled insects were preserved in 70% alcohol for laboratory work. Sampled fields and their geographical information systems information are detailed in Table 1.

Table 1: Information on the thirty selected on-farm potato fields in Mbeya and Njombe regions

Region/District	Village name	Crop stage	Latitudes (S)	Latitudes (E)
Mbeya rural	1 Itizi	Near to maturity	9°11´	33 °40´
Mbeya rural	2 Sanje	Flowering	9°12´	33 °41´
Mbeya rural	3 Jojo	Near to maturity	9°11´	33 °33´
Mbeya rural	4 Santiliya	Flowering	9°11´	33 °36´
Mbeya rural	5 Idimi	Flowering	8°83´	33 °46´
Mbeya rural	6 Haporoto	Flowering	8°84´	33 °49´
Mbeya rural	7 Ifiga	Near to Maturity	8°93´	33 °57´
Mbeya rural	8 Atwelo	Near to maturity	8°95´	33 °58´
Mbeya rural	9 Simambwe	Near to maturity	8°97´	33 °62´
Rungwe district	10 Usoha	Near to maturity	9°00´	33 °62´
Rungwe district	11 Lukata	Near to maturity	9°15´	33 °52´
Rungwedistrict	12 Swaya	Near to maturity	9°08´	33 °52´
Rungwedistrict	13 Ulembwe	Near to maturity	9°32´	34 ° 66´
Wanyingombe	14 Ulemwe	Near to maturity	9°04´	33 °59´
Wanyingombe	15 Mtolelo	Near to maturity	9°12´	33 °33´
Wanyingombe	16 Usalule	Near to maturity	9°33´	34 °62´
Wanyingombe	17 Nganda	Near to maturity	9°34´	36 °56´
Wanyingombe	18 Igosi 1	Near to maturity	9°31´	34 °53´
Wanyingombe	19 Igosi 2	Near to maturity	9°28´	33 °33´
Wanyingombe	20 Kilenzi	Near to maturity	9°43´	34 °75´
Wanyingombe	21 Kisilo	Near to maturity	9°45´	34 °76´
Njombe urban	22 Lunyanyu	Near to maturity	9°12´	33 °33´
Njombe urban	23 Utelela	Near to maturity	9°12´	33 °33´
Njombe urban	24 Luponde	Near to maturity	8°54´	34 °70´
Njombe rural	25 Irunda	Near to maturity	8°99´	34 °83´
Njombe rural	26 Mtwango	Near to maturity	9°02´	34 °82´
Njombe rural	27 Itipigi	Near to maturity	9°12´	33 °33´
Njombe rural	28 Itipigi 2	Near to maturity	8°98´	34 °87´
Njombe rural	29 Ulembwe	Near to maturity	9°30´	34 °63´
Njombe rural	30 Kichiwa	Near to maturity	9°05´	34 °87´

3. Data analysis

The relative abundance of potato aphids and other economical arthropods were analyzed from each transect line using one-way ANOVA and two tailed test to compare abundance of aphids and Coccinellids population.

3.1 Taxonomy

In the laboratory, identification of the potato aphids was carried out to the species level using dissecting microscope with the aid of appropriate keys (Teulon *et al*. 1999).

4.0 Results

4.1 Aphid population abundance

A total of 1,370 aphid populations were sampled during the survey period. Abundance from young leaves was 898, followed by medium leaves 270 and the least was old leaves represented by 202 individuals. The relative abundance of aphid population resulted from 15 minutes sampling effort per transect ranked from 8 individuals from Swaya village to 171 individuals from Atwelo village and the rest were in between (Figure 1). These results showed that there was extremely significant differences comparison of aphid population between upper leaves and medium leaves implying that aphid abundance were not equally distributed. Furthermore, results of comparison between upper and lower leaves showed significant differences, similarly mid and lower comparison showed no significance differences (P>0.05) (Figure 2).

4.2 Aphid and Coccinellid larva abundance

The aphid and Coccinellid abundance as a primary predator showed there were extremely significant differences in parasitism from different selected farms (P <0.0001) (Figure 3).The coccinellid abundance were ranging from zero to 32 individuals at Kichiwa. Similarl comparison between winged aphids, coccinellids and wingless aphids showed significance differences (Table 3).

5 Results discussion

5.1 Aphid population abundance

M. persicae was the primary occurring species in the selected surveyed areas. Aphid population from fields which were not frequently sprayed with non selective insecticide were represented with high population of aphid as well as natural enemies compared with frequent sprayed farms in contrast with Rowe, (1993). Aphid population was frequently sampled from the lower surface of the leaves than the upper surface probably because there was protection from sun intensity, wind and rain. On the other hand, potato aphid *M. persicae* was observed feeding on the young leaves, undersurface of the leaves, middle and lower leaves. Wingless aphids were observed climbing from tender leaves, flowers and back to the mid leaves where probably situations were more favorable in terms of food quality. Few winged aphids were observed migrating from plant to plant, young leaves, mid and old leaves probably looking for suitable areas for depositing eggs. Furthermore, in areas where the area under potato was large enough the population of winged aphid was observed to be less probably due to different climatic conditions *i.e.* strong wind (Barlow, 1962). With regard to different age of potato plants *i.e.* near to maturity stage, it was observed that aphids were less attracted to old potato plant parts. Where large number of aphid population is found feeding on young leaves it should be taken into consideration as one of the potential vectors of potato virus diseases and it arises a need to monitor population of insect vectors regularly in potato growing areas.

5.2 Comparison between aphid young leaves, medium and lower leaves

Comparison of aphid population between upper or young leaves and mid leaves showed significant differences implying that aphid population from different levels of sampling were not equally distributed. Similar results were obtained between upper and lower leaves. However, comparison between mid and lower leaves showed no significant differences from each other implying that abundance of aphid population was equally distributed (Table 2).

5.3 Comparison between aphid and coccinellid larva abundance

The two tailed P value comparison between aphid abundance and their natural enemies showed there was extremely significant differences (P= 0.0001). This result was due to different farm practices *i.e* spraying different insecticides to control aphid population in their potato fields. It is advisable to know the biology and ecology of the pest before employing any control measures related to reduce pest population pressure (Aheer *et al*., 1992). Coccinellid larva abundance varies from plant to plant and different plant parts. Therefore, it is necessary to conserve natural predators in potato farms at any time when planning for control measures of aphid

in potato farms. The adult ladybird beetle was observed migrating from one plant to another to locate suitable areas for egg laying in contrast with Evans (2003). Furthermore, comparson between wingless aphid and coccinellid showed significant differences but comparison between coccinellids and winged aphids showed no significant differences implying both individuals were equally distributed from the selected potato farms. (Table 3).

5. Conclusion

Sampling of potato aphid abundance showed that the distribution of insect vectors of virus diseases of potato was not equally distributed from one field to another. Mono cropping fields were more likely to have uniformity in population distribution. Furthermore, age of the leaves or crop stage near to maturity was another factor which caused poor aphid population distribution during the survey period. Both local potato cultivars and improved potato varieties were observed to be highly susceptible to aphid infestation. Reduction of insecticides use in the potato growing areas may increase presence of natural enemies especially coccinelids thus providing an opportunity to investigate possibility of introducing Integrated Pest Management (IPM) strategies in potato growing areas of Tanzania.

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References

Aheer, G. M., N.Ahmad, M. Ahmad and M. Ashrat, (1992). Chemical control of green peach aphid (Myzus persicae Sulzer) on potato crop. J. Agric. Res. 30: 501-505.

Barlow C. A. (1962).The influence of temperature on the growth of experimental populations of *Myzus persicae* (Sulzer) and *Macrosiphum euphorbiae* (Thomas) (Aphididae).Can. J. Zool. 40: 146-156.

Blackman R. L. and Eastop, V. F. (2000): Aphids on the World's Crop – An Identification and Information Guide- 2nd Edition. John Wiley & Sons, LTD, England; pp 1-466.

EPPO (2005): EPPO Standard PP 1/230 (1) Aphids on potatoes. Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig, Germany.

Evans, E.W. (2003). Searching and reproductive behaviour of female aphidophagous ladybirds (Coleoptera: Coccinellidae): a review. Eur. J. Entomol. 100, 1–10.

Cloyd R. A. & C. S. Sadof. (1998). Aphids: Biology and Management. Floriculture Indiana.Vol. 12. No.2: 3-7.

Flanders K. L., E. B. Radcliffe & D. W. Ragsdale. (1991). Potato leaf roll virus spread in relation to densities of Green peach aphid (Homoptera: Aphididae). Implications for management threshold for Minnesota seed potatoes. J. Econ. Entomol. 84:1028-1036.

Godfrey L. D. (1997). Potato aphids (*Myzus persicae*, *Macrosiphum euphorbiae*). UC Pest Management Guidelines. University of California, Statewide Integrated Pest Management Project: 1-3.

Hooker W. J. (1986). Compendium of Potato Diseases. The APS, 3340 Pilot Knob Road, St. Paul, Minnesota 55121, USA: 125 p.

Oetting R. D. (1985). Identification, biology and control of aphids and whiteflies on bedding plants and poinsettias. In Proc. First Conf. On Insects and Disease Management On Ornamentals (M.A. Parrella, ed), Society of American Florists, Alexandria, Virginia: 63-66.

Rowe R. C. (1993). Potato Health Management of Potato Insects Pests and Vectored Diseases. Oregon Potatoes 1994-95 Research Project Reports: 11-13.

Stephanie Bailey (1993). Ladybugs. University of Kentucky, Kentucky State University, US Department of Agriculture and Kentucky Countries, Cooperating: 2 p.

Teulon D. A. J., V. F. Eastop, M. A. W. Stufkens & S. J. Hartcourt, (1999). Illustrated multipleentry key for apterous aphids of economic importance in New Zealand. Crop &Food Research Report, No. 612. Crop & Food Research, Lincoln, New Zealand: 140 p.

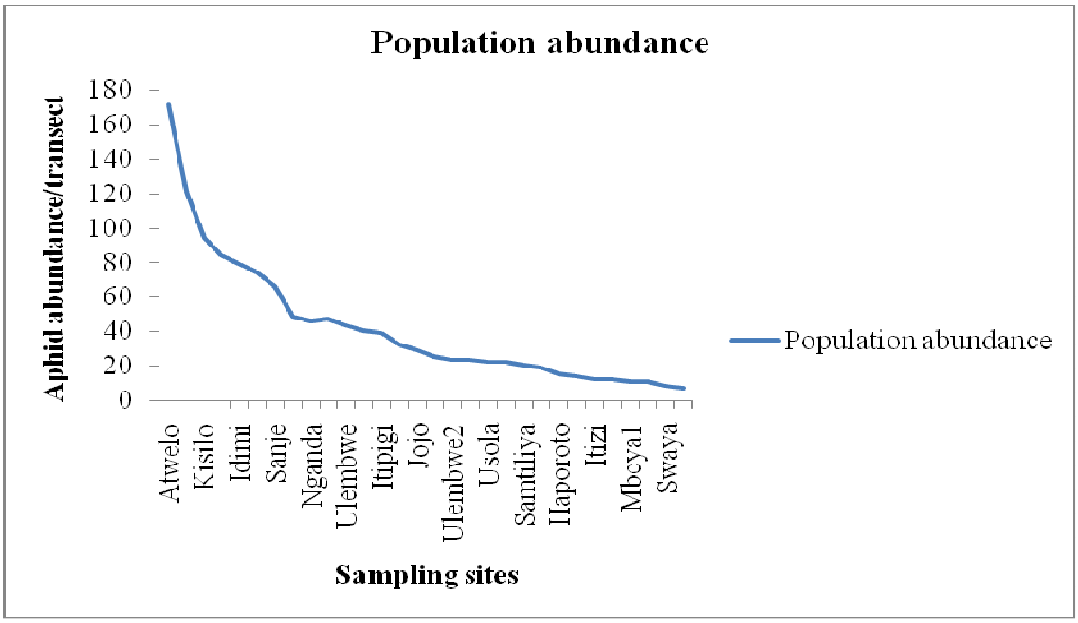

Figure 1: Ranked potato aphid abundance sampled from different potato growing areas in Mbeya and Njombe regions

Table 2: Comparison of aphid population from different plant parts

Comparison	Mean differences	Q	P-value	
Upper leaves Vs Mid leaves	3.548	8.221	***	P<0.001
Upper Vs Lower	3.932	9.112	***	P<0.001
Mid Vs Lower	0.384	0.890	Ns	P>0.05

NB: Upper leaves include flowers, young leaves, Mid leaves were located below young leaves, Lower leaves includes all old leaves near to the soil surface.

Table 3: Comparison of wingless aphids, coccinellids and winged aphids

Comparison	Mean differences	Q	P-value	
Wingless Vs Coccinellids	34.63	8.50	***	P<0.001
Wingless Vs Winged aphids	40.56	9.96	***	P<0.001
Cocinellids Vs Winged aphids	5.95	1.45	Ns	P>0.05

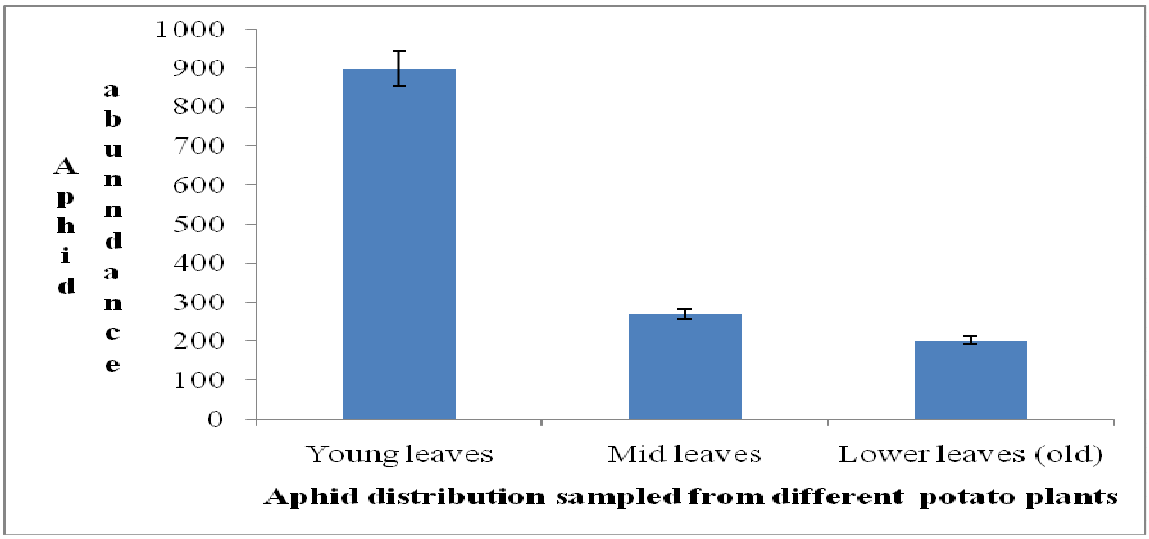

Figure 2: Aphid distribution from different plant parts sampled from surveyed sites

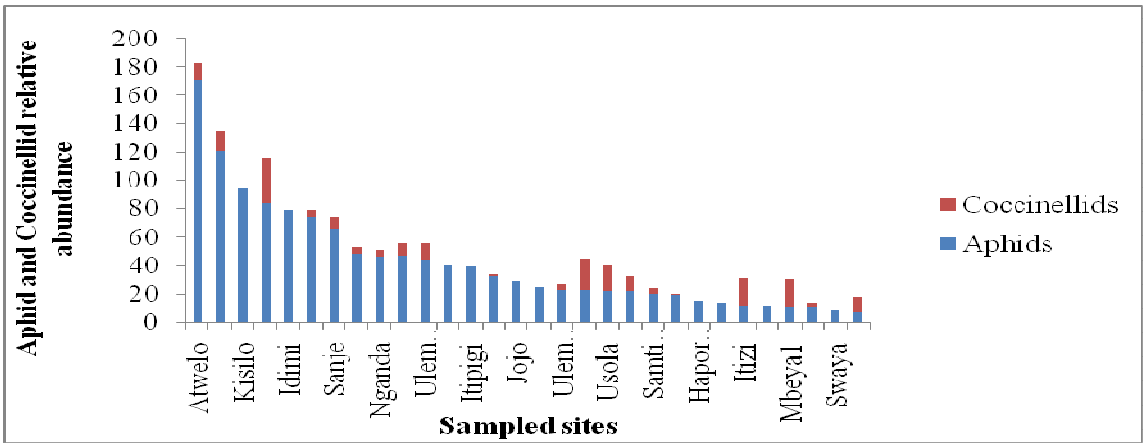

Figure 3: Relative abundance of aphid and Coccinellids larva sampled from different surveyed sites