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Vol. 11(18), pp. 1656-1660, 5 May, 2016
DOI: 10.5897/AJAR2015.10721
Article Number: C63BF4658395
ISSN 1991-637X

http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Effects of irrigated and rain fed conditions on infestation levels of thrips (Thysanoptera: Thripidae) infesting *Dolichos lablab* (L.) in Eastern Kenya

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Received 10 December, 2015; Accepted 1 April, 2016, 2016

***Dolichos lablab* (L.) is a neglected crop species in Kenya, grown only for subsistence where they are highly adapted to a small range of ecological niches. It is grown under irrigation and rain fed conditions, where production is limited by insect pests such as thrips (Genera: *Megalurothrips* and *Frankliniella*). However, the effects of irrigation and rain fed conditions on infestation levels of these thrips in Kenya are unknown. This study aimed at investigating the levels of infestation of thrips on *D. lablab* (L.) grown under rain fed and irrigated conditions in Meru Central and Yatta sub-counties, Kenya. Sampling was conducted biweekly from June, 2009 to February, 2010. In each sub-county, eight farms (four each irrigation and rain-fed) were randomly selected. The infestation levels were monitored using 5 quadrats (30 cm × 30 cm), placed randomly at each farm in every sampling session. The thrips population within each quadrat was estimated from 3 randomly selected shoots of *D. lablab.* Thrips samples were placed in 30 ml vials and transported in a cool box to the International Centre for Insect Physiology and Ecology (ICIPE) labs for sorting and identification. The abundance of thrips varied significantly between the irrigated and rain fed farms at both sub-counties. In Meru sub-county, thrips numbers averaged 352.3±36.1 for irrigated farms as compared to 199.1±26.3 for rain fed. In Yatta sub-county, the mean abundance for rain fed farms was 265.5±42.0 as compared to 235.4±37.2 for irrigated farms. *D. lablab* for irrigated farms were significantly more infested (Anova: p=0.05) than in rain fed farms.**

Key words: Infestation levels, sampling, irrigated, rain fed, quadrats.

INTRODUCTION

Dolichos lablab (L.), also known as *Lablab purpereus* (L.) is a neglected and under cultivated legume crop in Kenya and other parts of the world (Williams and Haq, 2002), as it is grown only in local production systems, where they

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are adapted to a small range of ecological niches and are highly underdeveloped due to lack of formal research input (Padulosi et al., 2006). In Kenya, the main *D. lablab* producing areas are Eastern, Central and Coast regions, where it's grown either as a pure stand or as an intercrop with maize (Ministry of Agriculture, Kenya Government, 2005).

D. lablab is a drought resistant and highly nutritious crop, but production is severely limited by pest infestations, especially thrips. The few farmers growing the crop have had decreasing levels of attainable yields due to pest infestations, with production ranging from 800 to 900 kg ha^{-1}, which is far less than the estimated yield potential of 2700 to 3000 kg ha^{-1} (Kamau et al., 2010; Kinyua et al., 2008). As a result of the low production, *D. lablab* is often being replaced with other legume crops such as common and French beans, which may not withstand the harsh environmental conditions in such areas.

In Kenya, *D. lablab* is grown under both irrigation and rain fed conditions. In the eastern region, the vegetable type is grown under irrigation while the grain type relies on rains. The vegetable type is locally known as *Varole* and is a perennial type grown mainly for its young fresh pods. It is trellised and climb on the stakes up to three meters high before it starts growing horizontally. It remains ever green throughout the production period as long as there is water for irrigation. The grain type on the other hand is annual and mainly grown for its fresh or dry grains. It is drought resistant and remains ever green during the dry season long after other crops have dried (Maundu et al., 1999). In both sub-counties, rains have been reported to be erratic and unreliable with annual average ranging between 500 to 800 mm (Wambugu et al., 2010)

The proliferation of insect pests such as thrips is more favorable in warm climates (Anonymous, 2006). In such climates, irrigation can stimulate the insect pest population levels (Kannan and Mohammed, 2001). In India, production of *D. lablab* is limited by a wide range of insect pests, but thrips were found to be the major insect pests in both irrigated and rain fed conditions (Thejaswi et al., 2007; Rekha and Mallapur, 2009). For *D. lablab*, irrigation can extend the growing seasons which enables insect pests to complete a greater number of reproductive cycles (Kannan and Mohammed, 2001). This can lead to increased pest infestations, with farmers needing to apply higher levels of chemical pesticides with an aim of controlling *D. lablab* pests, particularly thrips.

In Kenya, information on infestation levels of thrip species associated with *D. lablab* in irrigated and rain fed conditions is lacking. However, thrips of the genus *Frankliniella* and *Megalurothrips* have been reported to infest *D. lablab* in the eastern region of Kenya (Kamau et al., 2010). These genera were found in young leaves, flower buds, flowers and young pods. In India, rain fed and irrigated *D. lablab,* severe infestation was characterized by flower and pod malformation, distortion and scarification, while flower buds did not open but aborted prematurely (Thejaswi et al., 2007).

This study aimed at investigating the effects of irrigated and rain fed conditions on the thrips species and their infestation levels in D*. lablab*.

MATERIALS AND METHODS

Thrips infestation levels on D. *lablab* were evaluated biweekly throughout the two seasons in Yatta (37°53' E and 1°56'S) and Meru Central (37°30'E and 2°50'S) Sub-counties, in the eastern region of Kenya (Figure 1). In Yatta, rains were reported to be erratic and unreliable with annual average ranging between 500 to 800 mm (Wambugu et al., 2010) while in Meru, the annual average received was as low as 500 mm. The average lowest and highest temperatures in Meru were recorded as 16 and 23°C respectively (Oginosaka et al., 2006).

Average minimum and maximum temperatures for Yatta were 13.8 and 30.7°C sequentially (Kang'au, 2011). Studies were carried out under farmers' field conditions during the dry (June, 2009 to October, 2009) and wet seasons (November, 2009 to February, 2010). In both sub-counties, *D. lablab* was grown under irrigation and rain fed conditions. Four-irrigated (vegetable type) and four rain-fed (grain type) farms were randomly selected in each sub-county, totaling 16 farms (farms 1 to 8 in Meru and 9 to 16 in Yatta) in the 2 sub-counties. At each farm, thrips infestation levels were assessed from a set of 4 randomly selected *D. lablab* plants; which were selected from five randomly selected points on the study farms. The sampling of *D. lablab* was done at the seedling and vegetative stages, before the twigs intertwined to form a single canopy during every sampling session. Infestation levels were further assessed at the vegetative and podding stages, when the crop twigs intertwined and formed a dense canopy using a 30 cm x 30 cm quadrat (0.09 m^2).

From each set of four *D. lablab* plants or the plant parts within the quadrat, thrips populations were estimated by picking three randomly selected shoots, and their leaves, flowers and flower buds placed in 30 ml vials. The thrips samples were taken to ICIPE laboratories in Nairobi for sorting and identification. In the laboratory, the leaves, flowers and flower buds were opened and adult thrips and nymphs extracted by washing in 70% alcohol. All the thrips were then sorted, identified, counted and recorded. Identification was done using characteristics such as color, the rows of setae along the veins of the fore wings, the number of antennal segments and the positioning of the pair of setae III on the imaginary triangle of the occelli (Ralph, 1998; Stiller, 2001).

All the thrips species from the plant parts collected from the set of 4 plants or the quadrat were sorted according to their characteristics, identified, counted and recorded. The data was then analyzed using Genstat Statistical Software, version 14. To determine if the infestation levels of thrips on *D. lablab* differed significantly between irrigated and rain fed *D. lablab, ANOVA* was performed on transformed count data. *Post hoc* test was done using the Student-Neuman-Keuls test. The rejection level was set at $\alpha < 0.05$.

RESULTS

Thrips species in irrigated and rain-fed *D. lablab* in Meru sub-county were dominated by *Megalurothrips sjostedti* during both dry and rainy seasons. During the dry season, adults of *M. sjostedti* infesting *D. lablab* were

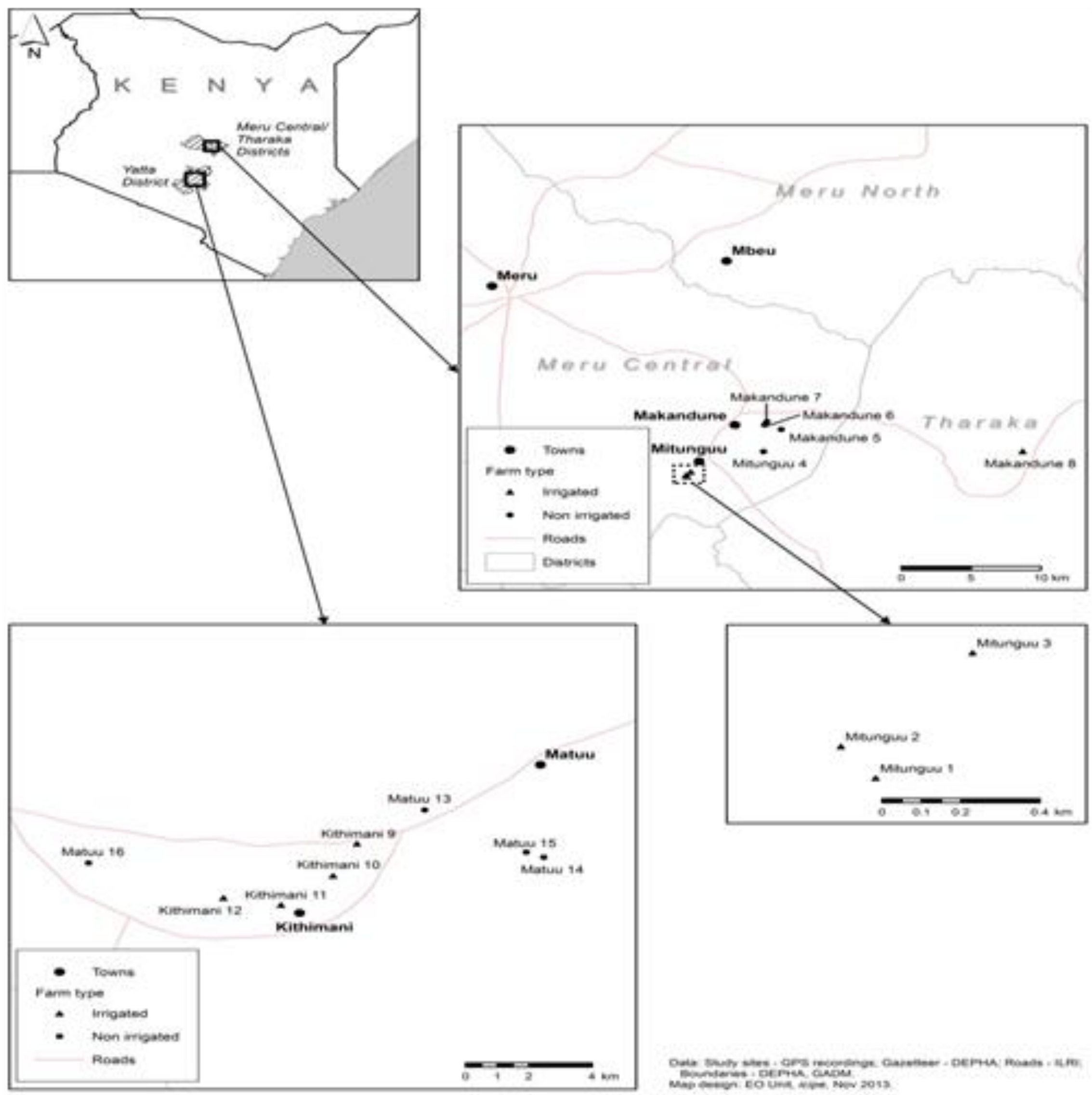

Figure 1. Location of the study sites in Meru Central and Yatta Sub-counties, Kenya.

significantly higher ($F_{(3,57)}$=4.73; $p<0.05$) on irrigated farms with a mean number of 176.2±11.0 as compared to 117.1±3.0 on rain fed farms (Table 1). Infestations were also significantly higher in irrigated farms ($F_{(3,71)}$=8.41; $p<0.05$) during the wet season with a mean of 109.4±10.8 as compared to 19.6±7.9 thrips on rain-fed farms (Table 2).

In Yatta Sub-county, however, rain-fed *D. lablab* had a significantly higher number of adult *M. sjostedti* ($F_{(3,57)}$=4.73; $p<0.05$), averaging 117.2±18.3 as compared to 59.6±12.2 in irrigated *D. lablab* during the dry season (Table 1). Similarly, during the rainy season, infestation by adult *M. sjostedti* was also significantly higher in the rain-fed ($F_{(3,71)}$=8.41; $p<0.05$) than the irrigated *D. lablab*, averaging 114.3±10.2 as compared to 141.7±11.0 in the rainy and irrigated farms, respectively (Table 2).

Other species of thrips commonly infesting *D. lablab* in Meru and Yatta Sub-counties were *Frankliniella occidentallis* (Pergade), *Frankliniella schultezi* (Pergade) and *Hydatothrips* spp. The infestation levels of adult *F. occidentallis* in Meru sub-county was highest in irrigated *D. lablab* during the dry season, with a mean of 10.7±2.0, which was significantly higher ($F_{(3,57)}$=3.15; $p<0.05$) than rain-fed *D. lablab* 2.6±1.4 (Table 1). During the wet season, infestation levels of adult *F. occidentallis* were similarly significantly higher ($F_{(3,54)}$=0.88; $p<0.05$) in the irrigated *D. lablab*, averaging 30.6±4.3 as compared to 23.7±5.1 in rain-fed *D. lablab.*

In contrast, infestation rates by *F. occidentallis* in Yatta Sub-county were lower in the irrigated than in the rain fed *D. lablab* during the dry season (Table 1). However,

Table 1. Means (±SE) of counts of various thrips species in irrigated (vegetable type) and rain fed (grain type) conditions in Meru central and Yatta sub-counties (Dry season). Means with the same letter within the same row are not significantly different at α<0.05. Means separated using SNK test.

Thrips species	Means (±SE) of counts per m²			
	Meru		Yatta	
	Irrigated (vegetable type)	Rainfed (grain type)	Irrigated (vegetable type)	Rainfed (grain type)
M. sjostedti	176.2±11.0[c]	117.1±3.0[b]	59.6±12.2[a]	117.2±18.3[c]
F.occidentallis	10.7±2.0[b]	2.6±1.4[a]	1.3±1.1[a]	3.7±2.2a[b]
F. schultzei	10.0±2.0[b]	7.4±2.6[ab]	4.1±2.2[a]	5.6±3.3[ab]
Hydatothrips spp.	4.7±1.6[a]	9.0±2.0[b]	3.3±1.8[a]	2.7±2.0[a]

Table 2. Means (±SE) of counts of various thrips species in irrigated (vegetable type) and rain fed (grain type) conditions in Meru central and sub-counties Yatta (Wet season). Means with the same letter within the same row are not significantly different at p<0.05. Means separated using SNK test.

Thrips species	Means (±SE) of counts per m²			
	Meru		Yatta	
	Irrigated (vegetable type)	Rain fed (grain type)	Irrigated (vegetable type)	Rain fed (grain type)
M. sjostedti	109.4±10.8[b]	19.6±7.9[a]	141.7±11.0[d]	114.3±10.2[c]
F. occidentallis	30.6±4.3[b]	23.7±5.1[ab]	15.9±4.3[ab]	8.9±4.1[a]
F. schultzei	7.8±2.0[a]	10.0±2.3[a]	5.7±2.0[a]	3.1±1.9[a]
Hydatothrips spp.	2.9±2.4[a]	9.7±3.0[b]	3.8±2.6[a]	10.9±2.3[b]

during the wet season, infestation rates by *F. occidentallis* were significantly higher in irrigated than in rain-fed *D. lablab* (Table 2). During the dry season, infestation level of *Hydatothrips* spp. was significantly higher in rain fed *D. lablab* in Meru, with adult mean numbers of 9.0±2.0 compared to irrigated *D. lablab* in both sub-counties (Table 1). In wet season, the highest infestation of *Hydatothrips* spp. was in rain fed *D. lablab* in both Meru and Yatta with adult mean numbers of 9.7±3.0 and 10.9±2.3 respectively. These means were not significantly different ($F_{(3,71)}=1.75$; $p>0.05$) from each other. However, they were significantly higher ($F_{(3,71)}=1.75$; $p<0.05$) than irrigated *D. lablab* in both Meru and Yatta (2.9±2.4 and 3.8±2.6) (Table 2).

DISCUSSION

From the results, thrips infestation levels were significantly higher in irrigated *D. lablab* compared to rain fed in Meru. Irrigation provided good growing conditions for the *D. lablab* plants to ensure rapid growth hence enough shoots and flowers for thrips to feed on. This is in line with the findings of Kasina et al. (2009) who found that flower thrips infestation was high in the shoots and flowers compared to other parts of the crop. In *D. lablab*, irrigation brings about longer growing seasons which enables these species of thrips to complete a greater number of reproductive cycles during the growing season (Kannan and Mohammed, 2001).

However, environmental stress such as drought weakens plants and makes them more susceptible to thrips attack. This explains why the *M. sjostedti* infestation levels were higher in rain fed compared to irrigated in Yatta. This was observed by Gitonga (1999) in French beans who reported that plants under water stress are very susceptible to direct thrips damage. *Megalurothrips sjostedti* is widely spread in sub Saharan Africa and highly polyphagous in the family *leguminosea* (Seif *et al.,* 2001). This suggests why *M. sjostedti* was more abundant than any other thrip species in this study.

Conclusion

Infestation levels of the species of thrips attacking *D. lablab* in Meru central and Yatta sub-counties of eastern region of Kenya varied significantly between irrigated and rain fed conditions. *Megalurothrips sjostedti, F. occidentallis* and *F. schultzei* infestation levels were significantly higher in irrigated *D. lablab* (vegetable type) than rain fed *D lablab* (grain type) in Meru central. This was extremely different in Yatta where *M. sjostedti* infestation levels were significantly higher in rain fed than irrigated.

Hydatothrips spp. infestation levels were significantly higher in rain fed *D. lablab* compared to irrigated *D. lablab* in both sub - counties*.*

ACKNOWLEDGEMENTS

The authors are greatly indebted to Capacity Building Department of International Center of Insect Physiology and Ecology for granting the scholarship for this study through Dissertation and Research Internship Program (DRIP). The authors appreciate the help extended to them by the *Dolichos lablab* (L.) farmers from Yatta and Meru central Sub-counties for allowing them to work on their farms for two cropping seasons. Particularly, they also appreciate the efforts of Margaret, a farmer in Meru Central sub-county who organized and coordinated the other *D. lablab* farmers.

Conflict of Interests

The authors have not declared any conflict of interests.

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