Research Journal of Agriculture and Forestry Sciences ______________________________E-ISSN 2320-6063
Vol. **4(9),** 1-5, September **(2016)** *Res. J. Agriculture and Forestry Sci.*

Susceptibility of Mulberry Accessions Grown in Kenya to Insect Pests under Field Conditions

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Available online at: www.isca.in, www.isca.me
Received 28th June 2016, revised 14th August 2016, accepted 28th August 2016

Abstract

Evaluation of several mulberry accessions against insect pests has not been done extensively, leading to use of mulberry leaves that lower silk worm growth and silk cocoon production. The incidence and severity of major insect pests attacking mulberry grown in Kenya under natural infestation in field conditions was evaluated. Five mulberry accessions including Thailand, Thika, Embu, S41, and Kanva-2 were laid out in a randomized complete block design (RCBD) with three replications. Pest damage was scored and Analysis of Variance (ANOVA) was used to test significance of the different means. Major insect pests were wingless grasshopper (Neorthacrisacuticepsnilgirensis) and long snout beetle (Sitonagressorius). Thailand had the highest infestation percentage of 54.3%, followed by S41 with 47.8%, Kanva 2, 43%, Embu, 41.2% and Thika 33%. Varietal rating to insect pest susceptibility showed that Thailand accession was susceptible. S41, Kanva-2, Thika and Embu accessions were moderately resistant. These varieties can therefore be utilized in mulberry improvement programmes.

Keywords: Mulberry, Susceptibility, Resistance, Accessions.

Introduction

Mulberry (*Morusspp*) belongs to the family Moraceae. Moraceae contains a large group of tropical and sub-tropical plants, comprising 55 genera and about 1000 species of herbs, shrubs and trees[1]. In Kenya, mulberry is grown for its medicinal value, edible fruits, livestock fodder, timber, silkworm feed and as a social amenity tree[2]. Mulberry (*Morusspp*) is an economically important plant for sericulture, livestock and medicinal purposes. Productivity of silk is dependent on quality and increase in mulberry leaf yield per unit area. Insect pests are some of production constraints in mulberry cultivation.

Insect pests attacking the different mulberry accessions are an important factor that should be considered since nutritious leaves play an important role in silk worm growth and silk cocoon production[3]. Mulberry cultivation and utilization has increasingly become an income generation for the rural small-scale farmers of Kenya[4]. The major pests of mulberry are Mealy bugs (*Maconellicoccushirsutus*) which are vectors of the Tukra disease, mulberry leaf roller (*Diaphaniapulverulentalis*) and bihar hairy caterpillar (*Spilosoma oblique*). Due to the voracious feeding of these pests they have been found to reduce leaf yield by 10-20% and nutritive value of mulberry.

Control of pests and foliar diseases of mulberry has been by use of synthetic chemical, plant extracts and natural enemies[5-9]. Although effective and easy to use, increased use of synthetic insecticides has been found to cause environmental pollution, residual toxicity to silkworms and natural enemies[10]. Further, indiscriminate use of such chemicals has resulted in evolution of resistant strains[11]. Biological and botanical controls were found to be slow in effectiveness. Besides, botanical control measures lack residual action and so lose their effectiveness under full sunlight conditions through UV degradation[12].

Nevertheless, mulberry accessions introduced to Kenya as well as those that are indigenous have not been evaluated against pests and diseases. It was therefore imperative to assess Kenyan accessions of Mulberry against insect pests' resistance for future improvement andsuccess of the sericulture industry.

Materials and Methods

Experimental site: The assessment of mulberry accessions against insect pests was carried out in University of Eldoret, longitude 35°15'E, latitude 0°30'N. An altitude of 2180m ASL, the annual rainfall of the site at Chepkoilel Campus is between 624-1622mm and annual mean temperature is 17°C.

Nursery preparation: Ten mulberry accessions which included; Thailand, Thika, Embu, Ithanga, Limuru (*M. alba* L.), S41, S13, S54, S36 and Kanva-2 (*M. indica* L.) were obtained from the International Centre of Insect Physiology and Ecology (ICIPE) Mulberry Germplasm site at Nairobi headquarters' and Kenya Agricultural Research Institute (KARI) at Thika. Among them, only five mulberry accessions namely (Thailand, Thika, Embu (*M. alba* L.), S41 and Kanva-2 (*M. indica* L.) were used in the evaluation for insect pest susceptibility. Cuttings of size 15 – 20cm with 4-6 healthy buds were made. The cuttings were planted in a rooting media of sand and soil at a ratio of 2:1, respectively. Wooden boxes of 75X75X50cm were used for each variety. They were planted in a diagonal format leaving only two buds above the surface of the soil. After planting, the soil around the cuttings was pressed firmly and watered to field capacity. Thereafter watering of cuttings was done as and when required.

Field layout and experimentation: A randomized complete block design (RCBD) with three replications was used in this experiment. Five mulberry accessions cuttings which included; Thailand, Thika, Embu, S41, and Kanva-2 were planted at a distance of 3X3m in pit holes of 30X30X30cm deep. Each experimental unit consisted of six mulberry cuttings and a guard row surrounding the whole experimental plot. Farm yard manure was applied at the rate of 7 tons ha^{-1} prior to planting. NPK was applied in order to supply 16.8 kg N, 7.4 kg P_2O, and 13.8 kg K_2O ha^{-1} using the ring method, 60 days after transplanting. All plants were bottom pruned 30cm from ground level after six months of planting as per the procedure certified by[13]. A booster dose of urea was applied at 45 kg N ha^{-1} 35 days post-pruning. Plots were maintained weed free to the end of the experiment by hand weeding.

Data collection: Four mulberry plants per experimental unit were used in the collection of data. In the first mulberry cycle, infestation incidence was recorded at 7-day interval starting from the fourth to sixth month (September-November 2009) after planting. In the second cycle, data was collected from 63-109 days (January-February 2010) post-pruning.

The total number of insect pest infested leaves and healthy leaves were recorded from three longest branches on the six top fully mature leaves, to calculate insect pest incidence, infestation percentage and score for pest damage.

Pest damage was scored according to Amin P.W.[14] modified by ICRISAT. Where 1= No damage, 3= Low level of damage < 30%, 5= Moderate damage < 50%, 7= Severe damage <70%, 9= Heavy damage >90% .Where 1 = Highly Resistant, 2-3 = Resistant, 4-5 = Moderately Resistant, 6-7 = Susceptible, 8-9 = Highly Susceptible.

$$\text{Infestation percentage} = \frac{\text{Number of infested plants}}{\text{Number of sampled plants}} \times 100$$

Data analysis: Data was analyzed using the statistical package GenStat. The statistical model Yijk = μ+βi+ij+∑ijk was used, where μ was the general mean, βi was the block effect, ij was the treatment effect and ∑ijk was the error term.The data was first transformed from percentages to angular transformed values then analyzed. Analysis of Variance (ANOVA) was used to test significanceof the different means. Least significance difference (LSD) at p>0.05.

Results and Discussion

The major insect pests were wingless grasshopper (Neorthacrisacuticepsnilgirensis) and long snout beetle (Sitonagressorius). They caused major leaf damage/loss. High insect pest damage as well as numbers was not observed at initial stages of plant growth. However, by the fourth month, insect pest numbers as well as damage was seen. The leaf eating lady bird (Epilachna 28-punctata) was also noticed as one of the minor insect pests.

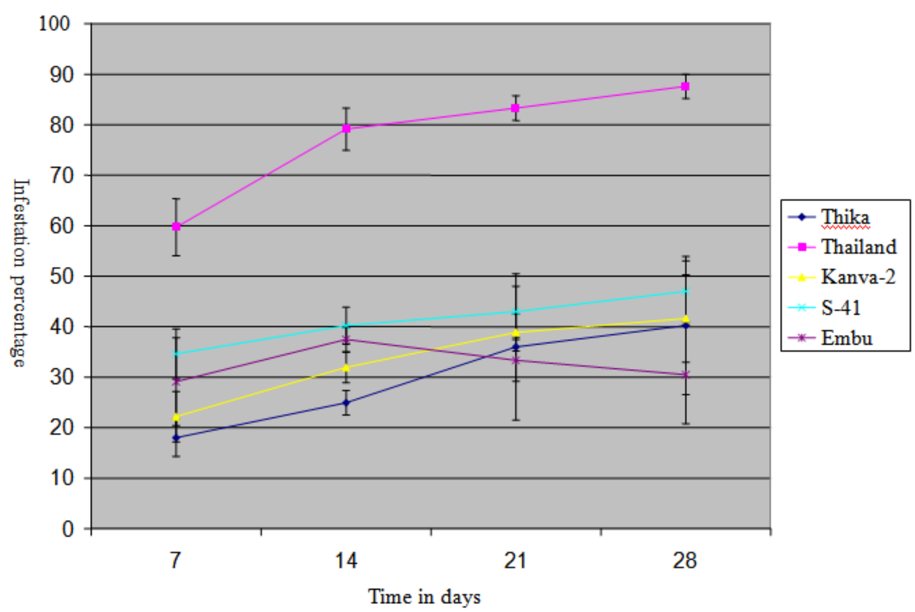

Figure-1
Infestation percentage by major leaf feeding insect pests across five mulberry accessions over time in cycle 1

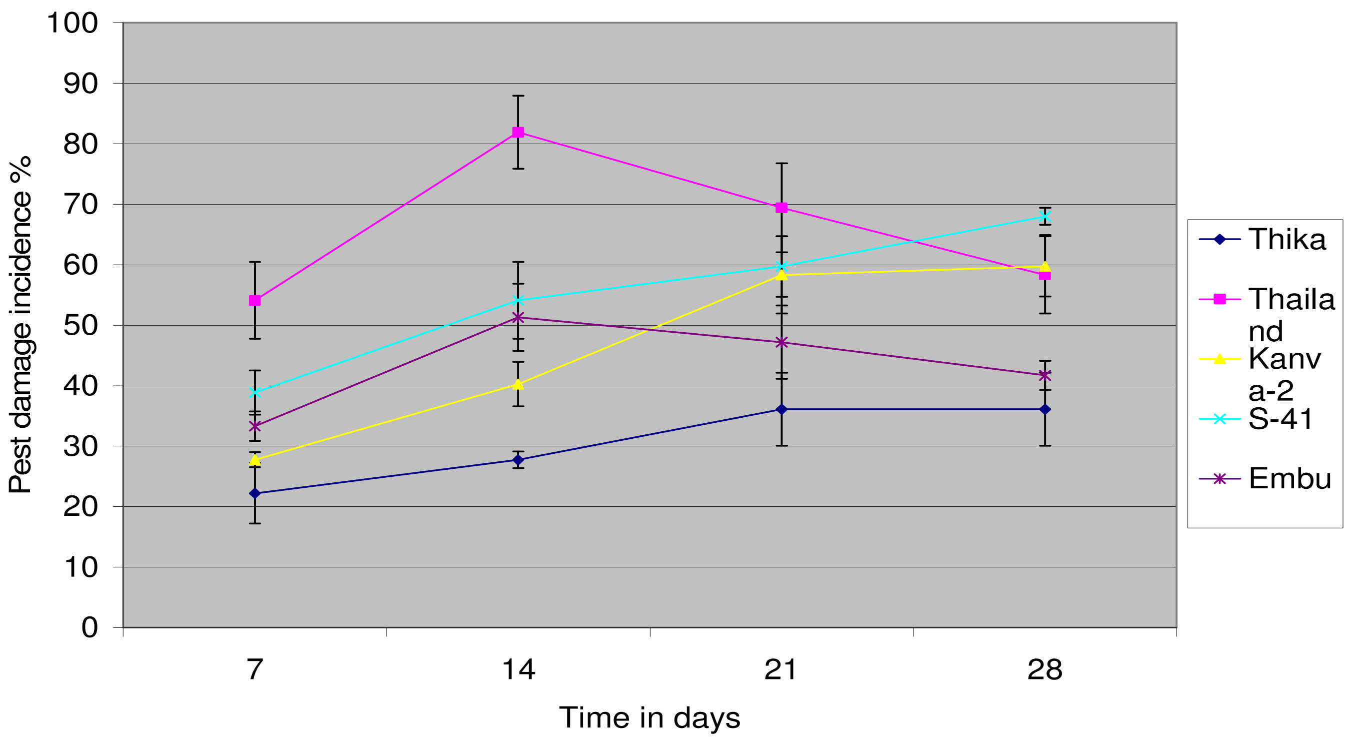

Figure-2
Infestation percentage by major leaf feeding insect pests across five mulberry accessions over time in cycle 2

Infestation percentage trend across the mulberry accessions studied: Infestation percentage (Figure-1) increased gradually in accessions Thailand, Kanva-2, Thika and S41 throughout the 28 days. Accession Embu, increased gradually in infestation percentage within the first 14 days and eventually declined. Nevertheless, all the accessions were not significantly different from each other except for Thailand. Thailand accession had the highest infestation percentage followed by S41, Kanva-2, Thikaand Embu accessions, respectively.

Infestation percentage in cycle 2 (Figure-2), increased gradually in S41 and Kanva-2 accessions throughout the 28 days. Accessions Embu and Thailand increased in their infestation percentage in the first 14 days but later declined. Thika accession increased gradually in infestation percentage in the first 21 days and remained steady to 28 days. Overally, all the mulberry accessions were not significantly different in the 21st to 28th day.

Means of pest damage and pest damage incidence (%) in different mulberry accessions: Infestation percentage across the mulberry accessions was not significantly different. Thailand accession was significantly different in pest damage from the rest of the accessions (Table-1).

Figures labeled with the same lower case letter indicate no significance while those with different letters indicate significance difference at p>0.05 (LSD).

Rating of the different mulberry accessions against insect pests: Rating of mulberry accessions against insect pests was taken using the infestation percentage means. The major insect pest damage was caused by the long snout beetle (Table-2).

Table-1
Means showing differences in infestation % and pest damage across the mulberry accessions tested

Accessions	Infestation %	Pest Damage
Thika	33.00a	4.00b
Thailand	54.30a	6.33a
Kanva-2	43.00a	4.50b
S41	47.80a	4.58b
Embu	41.20a	4.33b
Grand mean	43.90	4.75
Stardard error	5.00	0.46
Stardard deviation	4.08	0.37
Coefficient of variation (%)	12.90	9.70

Table-2
Overall rating of five mulberry accessions against insect pests

Accession	Means of pest damage incidence %	Rating
Thika	33.0	MR
Thailand	54.3	S
Kanva-2	43.0	MR
S-41	47.8	MR
Embu	41.2	MR

R= Resistant, MR= moderately resistant, MS= moderately susceptible, S= Susceptible

Discussion: Mulberry is an economically important plant grown under a wide range of agro-climatic conditions in Kenya. Insect Pests are some of the limiting factors in the successful mulberry cultivation causing substantial losses both in production and quality. Mulberry leaf yield and quality affect silkworm rearing and ultimate cocoon yield and silk production.

Pests cause considerable damage on leaves by windowing and voracious leaf feeding. Insect pests reported in this study were the leaf eating lady bird beetle (*Epilachna 28-punctata*), wingless grasshopper (*Neorthacrisacuticepsnilgirensis*) and snout bettle (*Sitonagressorius*). In cycle one, Thailand accession had the highest pest damage followed by S41, Kanva-2, Thika and Embu accessions. This could have been attributed to its smooth leaf surface as well as genetic component where pests prefer it due to certain biochemicals it produces. Most plants have intrinsic characteristics such as nutritive value, secondary chemistry and morphology that influence the fecundity, growth and survival of insects[15]. On the other hand, pests may be selective on the host they prefer; thereby accounting for the genetic component of the plant that leads to host susceptibility[16]. Conversely, Embu accession declined in pest damage with increase in disease. This could be attributed to reduced leaf quality due to reduced sap and leaf drying/dieing. In cycle 2, Thailand accession had the highest pest damage but later declined as disease incidence increased. Nonetheless[4] reported Thailand accession to have recorded the highest survival of silkworm during silkworm rearing. Therefore, Thailand accession was the most preferred by insect pests as well as the silkworm against other accessions. Pest damage increased on S41 and Kanva-2 as disease increased in the Embu accession. This was attributed to pest's search for better leaf quality. Thika accession was least preferred by pests. Varietal rating to pest showed that Thailand accession was susceptible. S41, Kanva-2, Thika and Embu accessions were moderately resistant. Resistance of pest to particular accessions could be attributed to the biochemical constitution of the plants as well as morphological characteristics of the plants which cause the pest to resist or prefer the host plant.

The wingless grasshopper was reported to cause substantial damage especially under severe conditions leading to 100% leaf yield losses rendering mulberry plants devoid of leaves in India[17]. Considerable damage occurs on the upper surface of potato and tomato leaves upon feeding by the leaf eating ladybird beetle[18]. In addition, observations in this study showed considerable damage on the mulberry leaf caused by the snout beetle where windowing ranged from 30-90% of the leaf surface.

Conclusion

Thailand accession showed higher incidence of pest damage thereby being susceptible to pest. Other accessions were moderately resistant to pest damage and therefore they can be utilized in mulberry improvement programmes.

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