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Evaluation of varied nitrogen dosages on population build up of cotton whitefly (*Bemisia tabaci*, Gennadius)

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Abstract
An experiment was conducted with an objective of studying the effect of varied nitrogen doses on population build up of cotton whitefly adults and its nymphs. The result revealed that, the whitefly adults and nymphs population was maximum on crop treated with excess dose of nitrogen fertilizer (5.89 adults and 8.1 nymphs/leaf). It was concluded from the trial that provision of nutrients to the plants in larger amounts in shorter period, leads to heavy insect population than the nutrient provision at recommended dose.

Keywords: cotton, whitefly, nitrogen dosages, population dynamics

Introduction
The Cotton (*Gossypium* spp.) crop is globally designated as "King of Fibres". The cotton crop as an agricultural commodity in the world has exercised a profound influence on human beings. Along with production of fibre for the textile industry it plays a major role in the feed, soap and vegetable oil industries as its seed rich in oil (18 – 24%) and protein (20 – 40%). Cotton is being cultivated as many as in 70 countries of the world with a total coverage of 31.24 million hectare in 2015-16 [2]. The major cotton producing countries in the world are China, India, USA and Pakistan sharing 71 per cent of the world's cotton area and production.

In India under diverse agro climatic conditions all four commercially fibre producing species of cotton *viz*., *Gossypium hirsutum*, *G. arboreum*, *G. herbaceum* and *G. barbadense* along with inter/ intra-species hybrids are cultivated. More than 60 million Indian people are engaged in cultivation, processing, marketing and other cotton related activities [6]. In India cotton is cultivated in 11.87 million hectare with a production of 484 million bales of seed cotton [1]. The average productivity of cotton in India is 537 kilogram lint per hectare which is low when compared to world average of 760 kilogram lint per hectare. In Haryana, cotton crop is grown in five major districts *viz*., Hisar, Fatehabad, Jind, Bhiwani and Sirsa. The total area under cotton is 6.03 lakh hectares and production is 15.00 lakh bales of 170 kilogram with productivity 423 kilogram per hectare [1]. The cotton production has greatly reduced in the year 2015 in Haryana and Punjab due to heavy attack of whitefly.

The pest status of bollworm complex in cotton has now declined owing to the introduction of bollworms resistant cotton varieties having gene from *Bacillus thuringiensis* Berliner. However, sucking insect pests are still a great threat to its cultivation and necessitate insecticidal applications to avoid yield losses [7, 8]. Whitefly has been reported as a major key pest during mid to late cotton growing season leading 50 per cent reduction in boll production and its high population may cause great damage by removing significant amount of phloem sap to reduce plant vigour [9]. It is a polyphagous pest and widely distributed in tropical and subtropical regions. Apart from direct damage it also causes indirect damage by acting as a vector of leaf curl virus disease and yellow mosaic virus [10]. Many workers have attributed abiotic factors as one of the major contributing factors to the outbreak of whitefly as its population is greatly affected by abiotic factors [13].

The population of whitefly as a sucking pest varies greatly with little change in dosages of fertilizer applied. Hence, bio-rational management strategy *viz*., various dosages of nutrients application is considered to be eco-friendly and give the insect-pests least chances to attack the crop or help the plants to escape from insect attack [12]. But the information is sparse on this management tactics.

Thus, the present studies with the objectives listed below were undertaken with an aim to determine whether any correlation existed between different dosages of fertilizer applied on cotton crop and whitefly population build up in the crop.

Materials and Method

Experimental Layout

An experiment was carried out during *kharif* season of 2016 at Entomology Research Area of CCS Haryana Agricultural University, Hisar. The experiment was conducted with split plot design (SPD) having 12 number of treatment combinations. The American cotton variety H-1117 was taken for the experiment which was conducted in an area of total 800 m². The crop was planted at a spacing of 67.5cm x 30cm in a plot size of 20 m x 16 m (main plot size) and 5 m x 4 m (sub plot size). The block borders of 1 m and 0.5 m were kept between main plots and sub-plots respectively.

Treatments

The treatments under present study included three different dates of sowing and four different dosages of nitrogen fertilizer. The experimental plot was divided into three main plots and cotton crop was sown at three different dates *viz.*, 7th May, 28th May and 20th June 2016 (D1, D2 and D3) at 15 days interval. Each main plot was sub divided into four sub-plots. The sub-plots have been treated with four different dosages of nitrogen fertilizer *viz*., 0, 50, 75 and 100 Kg/ha (N0, N1, N2 and N3). The nitrogen fertilizer was applied in split dose. The "Package of Practices of *Kharif* crops" of CCS Haryana Agricultural University, Hisar was followed to carry out all other cultural practices [3].

Observations

The observations were taken from 30 days after sowing (first week of June, 2016) till maturity of crop (second week of October). From each plot five plants were randomly selected and tagged. All the tagged plants were being observed. The adult whitefly population was counted from undersides of three fully formed leaves each one from upper, middle and lower canopy. The hand lens of power 10X was used to observe the nymphal population.

Statistical analysis

The data regarding whitefly population build up was made into average and expressed as number of adults/leaf. The averaged data were subjected to square root transformation before analysis. The transformed data were analyzed statistically by using the OPSTAT software, at e-library of CCSHAU, Hisar. The Fisher method of analysis of variance (ANOVA) 'F test' was used to determine the significance or non-significance between two means. If the 'F' test is found to be significant, the critical difference (CD) was calculated for comparison between two means [12]. The analysed results were correlated with different nitrogen dosages.

Results

Population build up of *Bemisia tabaci* adults at four different nitrogen dosages

It is evident that the population of adult whitefly remained below economic threshold in the crop of cotton treated with no nitrogen fertilizer (0.00 Kg/ha) and in the crop treated with lower dose of nitrogen fertilizer (50.00 Kg/ha) than the recommended dose throughout the crop period, though the maximum mean population was recorded during 37th Standard week (3.14 adults/leaf (Table-1)) in case of crop without nitrogen treatment and during 37th standard week (5.11 adults/leaf) in case of crop treated with lower dose of nitrogen. The adult whitefly population also remain below economic threshold in crop treated with recommended dose of nitrogen fertilizer (75.00 Kg/ha) throughout the crop period except during 37th and 38th standard week, when the adult whitefly population crosses the economic threshold and were recorded to be 6.59 adults/ leaf and 6.48 adults/leaf respectively. While in case of crop treated with excess dose of nitrogen fertilizer the adult whitefly population crosses the economic threshold many times like on 30th, 34th, 36th, 37th, 38th, 39th and 40th standard week (6.26, 6.37, 8.18, 9.59, 9.93, 8.52 and 6.74 adults/leaf) respectively.

Among the treatments the minimum mean population was found in crop having no fertilizer treatment (1.95 adults/leaf) followed by crop treated with 50 Kg/ha nitrogen dose (2.93 adults/leaf) and the crop treated with 75Kg/ha nitrogen dose (4.07 adult/leaf). While the maximum mean population was recorded from the crop treated with 100 Kg/ha nitrogen dose (5.89 adults/leaf). The significant difference has been recorded in all the four treatments of nitrogen fertilizer.

Population build up of *Bemisia tabaci* nymph at four different nitrogen dosages

The population of whitefly nymph was found low in cotton crop treated with no nitrogen fertilizer (0.00 Kg/ha) and lower dose of nitrogen fertilizer (50.00 Kg/ha) than the recommended dose throughout the crop period, though the maximum mean population was recorded during 36th Standard week (4.48 nymphs/leaf (Table-2)) and during 37th standard week (7.18 nymphs/leaf), respectively. The whitefly nymph population also found low in crop treated with recommended dose of nitrogen fertilizer (75.00 Kg/ha) throughout the crop period, though the maximum mean population was found at 30th standard week (9.93 nymphs/leaf), followed by 37th standard week (9.89 nymphs/leaf) and 36th standard week (9.67 nymphs/leaf). While in case of crop treated with excess dose of nitrogen fertilizer (100 Kg/ha) the whitefly nymph population was high throughout the crop period having peak population at 37th standard week (13.52 nymphs/leaf).

All the four treatments of nitrogen fertilizer have shown significant difference. Among the treatments the minimum mean population was found in crop having no fertilizer treatment (3.07 nymphs/leaf) followed by crop applied with 50 Kg/ha nitrogen dose (4.30 nymphs/leaf) and the crop applied with 75 Kg/ha nitrogen dose (6.18 nymphs/leaf). While the maximum mean population was recorded from the crop applied with 100 Kg/ha nitrogen dose (8.10 nymphs/leaf).

The Fig-1 depicts that the overall mean whitefly adults and nymphs population was maximum on crop treated with excess dose of nitrogen fertilizer (5.89 adult and 8.1 nymphs) while, the minimum population was found on crop without application of nitrogen fertilizer (1.95 adult and 3.07 nymphs).

Discussion

The results are at par with Shrirame *et al*. [11] who conducted an experiment to show the effects of different fertilizer levels on incidence of sucking pests on *Bt* cotton, which revealed that the fertilizer level of 120:60:60 Kg/ha was found significantly effective in recording less number of whitefly at 30 days after sowing. Whereas the highest number of whitefly

were observed at fertilizer levels of 180:90:90 kg/ha NPK at 30, 45 and 60 days after sowing. The present results are also in confirmation with Balakrishnan *et al.* [4] who inferred that the population of sucking pests was more on cotton treated with nitrogenous fertilizers because the inorganic fertilizers increase the plant growth that might be due to increased auxin content and provided nutrients to the plants in larger amounts in shorter period thus making the plant more attractive for the sucking insects. Likewise, Bi *et al.* [5] revealed that the impact of urea nitrogen fertilization on silverleaf whitefly on cotton had a positive response between nitrogen application rates and the measured levels of nitrate in petioles from mature cotton leaves and also a positive response between N application rates and the numbers of adult and immature whiteflies appearing during population peaks. The outcome of the findings conferred that with increase in nitrogen dose there is increase in the population build up of whitefly, which is supported by Shrirame *et al.* [11].

Conclusion

The overall mean whitefly adults and nymphs population was maximum on crop treated with excess dose of nitrogen fertilizer (5.89 adult and 8.1 nymphs) while, the minimum population was found on crop without application of nitrogen fertilizer (1.95 adult and 3.07 nymphs).

On the basis of above results it is concluded that cotton variety (H-1117) should be treated with recommended dose of nitrogenous fertilizer to avoid excess build up of whitefly population. If treated with higher nitrogen dosages (100 Kg N/ha) *i.e.* more than the recommended dosages (75 Kg N/ha) there was an acceleration in the whitefly population which might be due to increased auxin content in the plant.

Comparison of mean population of whitefly adults and nymphs at different nitrogen dosages

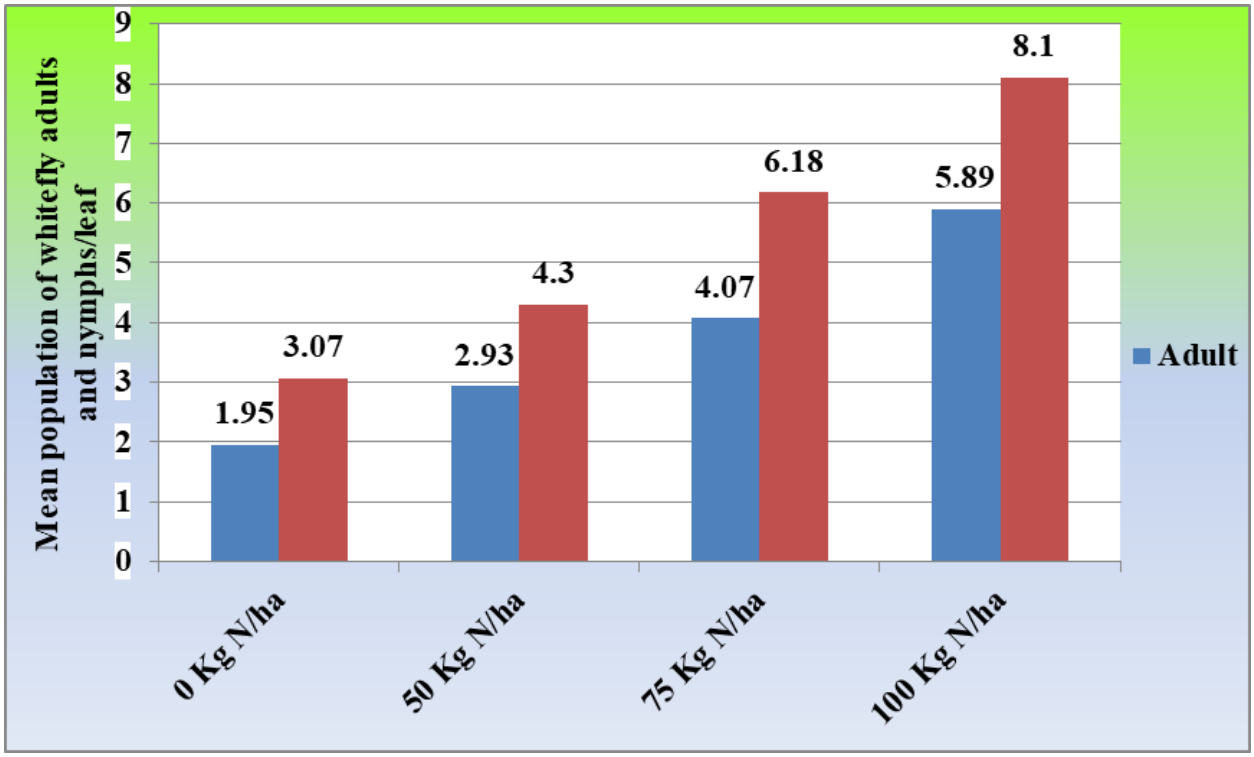

Fig 1: Mean population of whitefly adults and nymphs at different nitrogen dosages

Table 1: Population build up of whitefly adults on American cotton variety (H-1117) under varied Nitrogen dosages at different standard weeks during *kharif* 2016 season

Treatment	Mean population of whitefly (adult/leaf) during different period of observation from plots with varied nitrogen dosages standard week													Mean
	29	30	31	32	33	34	35	36	37	38	39	40	41	
N1 (0 Kg/ha)	1.44 (1.54)	1.63 (1.61)	0.89 (1.37)	1.30 (1.50)	1.81 (1.67)	2.00 (1.72)	1.41 (1.54)	3.07 (1.93)	3.14 (1.98)	2.93 (1.95)	2.82 (1.94)	1.37 (1.51)	1.56 (1.56)	1.95
N2 (50Kg/ha)	2.11 (1.73)	2.93 (1.96)	1.22 (1.47)	2.15 (1.77)	2.52 (1.86)	2.52 (1.86)	1.52 (1.58)	4.26 (2.23)	5.11 (2.39)	4.48 (2.29)	3.89 (2.19)	2.78 (1.93)	2.63 (1.89)	2.93
N3 (75Kg/ha)	1.78 (1.64)	4.63 (2.34)	1.30 (1.50)	3.63 (2.13)	3.96 (2.22)	3.96 (2.22)	1.59 (1.60)	5.63 (2.52)	6.59 (2.69)	6.48 (2.69)	5.48 (2.52)	4.19 (2.26)	3.67 (2.14)	4.07
N4 (100Kg/ha)	1.89 (1.68)	6.26 (2.65)	1.52 (1.58)	5.04 (2.45)	5.70 (2.58)	6.37 (2.71)	1.48 (1.55)	8.18 (2.97)	9.59 (3.14)	9.93 (3.23)	8.52 (3.04)	6.74 (2.74)	5.41 (2.53)	5.89
Mean	1.81	3.86	1.23	3.03	3.50	3.71	1.5	5.29	6.11	5.96	5.18	3.77	3.32	3.71
SE(m)±	(0.11)	(0.048)	(0.07)	(0.055)	(0.049)	(0.054)	(0.078)	(0.050)	(0.044)	(0.047)	(0.051)	(0.049)	(0.046)	
CD (P=0.05)	(N.S)	(0.14)	(N.S)	(0.16)	(0.15)	(0.16)	(N.S)	(0.15)	(0.13)	(0.14)	(0.15)	(0.147)	(0.13)	

Figures in parentheses are square root transformed value $\sqrt{(n+1}$

Table 2: Population build up of whitefly nymph on American cotton variety (H-1117) under varied Nitrogen dosages at different standard weeks during *kharif* 2016 season

Treatment	Mean population of whitefly (nymphs/leaf) during different period of observation from plots with varied nitrogen dosages standard week													Mean
	29	30	31	32	33	34	35	36	37	38	39	40	41	
N1 (0.00 Kg/ha)	1.85 (1.67)	3.74 (2.11)	2.04 (1.72)	2.15 (1.75)	2.67 (1.91)	3.63 (2.14)	2.33 (1.81)	4.48 (2.31)	4.37 (2.30)	3.67 (2.15)	3.56 (2.13)	3.00 (1.99)	2.48 (1.86)	3.07
N2 (50 Kg/ha)	1.74 (1.64)	5.93 (2.62)	2.30 (1.76)	3.33 (2.07)	3.74 (2.17)	4.82 (2.41)	2.56 (1.87)	6.52 (2.71)	7.18 (2.84)	5.29 (2.49)	5.56 (2.55)	3.22 (2.05)	3.74 (2.17)	4.30
N3 (75 Kg/ha)	1.99 (1.72)	9.93 (3.27)	3.00 (1.97)	5.59 (2.55)	6.26 (2.69)	7.11 (2.84)	2.26 (1.79)	9.67 (3.20)	9.89 (3.26)	7.74 (2.95)	8.26 (3.03)	3.30 (2.07)	5.37 (2.52)	6.18
N4 (100 Kg/ha)	1.89 (1.69)	13.19 (3.71)	3.07 (1.97)	7.81 (2.95)	8.85 (3.13)	10.48 (3.38)	2.30 (1.81)	13.07 (3.70)	13.52 (3.76)	10.59 (3.39)	11.33 (3.50)	3.19 (2.04)	6.07 (2.66)	8.10
Mean	1.87	8.19	2.60	4.72	5.38	6.51	2.36	8.44	8.74	6.82	7.18	3.18	4.42	5.42
SE(m)±	(0.086)	(0.059)	(0.139)	(0.057)	(0.039)	(0.032)	(0.089)	(0.037)	(0.043)	(0.035)	(0.030)	(0.048)	(0.035)	
CD (P=0.05)	(N.S)	(0.18)	(N.S)	(0.17)	(0.12)	(0.10)	(N.S)	(0.11)	(0.13)	(0.11)	(0.09)	(N.S)	(0.10)	

Figures in parentheses are square root transformed value ($\sqrt{(n+1)}$)

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