Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

JEZS Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(2): 1140-1145

Received: 11-01-2019
Accepted: 15-02-2019

VU Sonalkar
Department of Agricultural Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

Variation of major nutrients in leaves and their correlation with sucking pests of cotton, *Gossypium* spp.

VU Sonalkar

Abstract
Thirteen hirsutum and two arboreum cultivars were studied with objectives to know the major nutrient variation in cotton leaves and their association with major sucking pests at Akola. The populations of sucking pests on per three leaves were recorded 45 and 60 days after emergence (DAE). The samples were collected 45 and 60 DAE for plant nutrient estimation. The major nutrients viz., nitrogen phosphorous, potassium were estimated by standard procedure. Highest nitrogen per cent was noted in RCH-2 Bt followed in BNBt, RCH-2; whereas, DHY-286 noted least nitrogen per cent. The utmost of phosphorous was in DHY-286 and minimum per cent phosphorous was in RCH-2 Bt; however, it was not affected significantly within BNBt, Bunny Bt, RCH-2, Bunny, KDCH-9632, NHH-44 Bt and KDCH-9632. The mean potassium ranged from 1.603 to 1.68 and 1.610 to 1.685 per cent, respectively 45 and 60 DAE. The aphids had non-significant correlation with nitrogen, phosphorous and potassium in cotton leaves. The leafhopper population had significant positive association with nitrogen; whereas, significant negative correlation with phosphorous. The thrips population was significantly and positively correlated with potassium; while, other nutrients had non-significant impact. The whitefly adult population was affected significantly by increased potassium in cotton leaves while the other constituents do not have any significant impact on whitefly population.

Keywords: *Gossypium* spp, nutrients, cotton, sucking pest, hirsutum, arboreum

1. Introduction

Of the various reasons for low productivity of cotton, damage due to various insect pests is one of the important major constraints in cotton production and often causes heavy yield losses. Cotton *Gossypium* spp. is very sensitive in nature and damaged at its different phenological stages by different insect pests, which attack the roots, shoots, tender leaves and fruiting bodies. Cotton crop suffers heavy attack of sucking pests like aphids *Aphis gossypii* Glover, leafhoppers *Amrasca biguttula biguttula* (Ishida), thrips *Thrips tabaci* (Lind.), whitefly *Bemisia tabaci* (Genn.), mealy bug (*Phenacoccus solenopsis*), mites (*Tetranychus spp*.). Among these, aphids, whitefly, thrips and leafhopper are serious and dangerous. Cotton whitefly damages the crop by sucking cell sap resulting in a fifty per cent reduction in boll production (Ahmad *et al*., 2002) [1] and also acts as a vector of leaf curl virus disease (Nelson *et al*., 1998) [2].

Many problems arise with indiscriminate use of chemical pesticides (Pawar and Kadam 1995) [3] such as development resistance in sucking pests (Ahmad *et al*., 2002) [1] and farmers are not getting expected sucking pests control with chemical insecticides; moreover, many times there is an outbreak of leafhoppers and whitefly on cotton. Therefore, with a view to produce sustainable yield, eco-friendly pest control with growing resistant cotton cultivars offers the cheapest and the most harmless approach in an integrated pest management programme to manage sucking pest infestation.

The sucking pest population fluctuation observes from cultivar to cultivar due to certain morphological characters, nutrients, biochemical, etc. in cotton plant. The plants challenged by insects respond through changes in composition and properties in cell wall as well as in nutrients composition (Biosynthesis of secondary metabolites) (Hopkins and Huner, 2004) [4]. These characters link with resistance are leaf hairiness and biochemical factors like nitrogen, phosphorous, potassium, could be involved in. Therefore, some popular Bt and non Bt cotton cultivars were evaluated for their reaction to key sucking pests, their major nutrient constituents and association in between.

Correspondence
VU Sonalkar
Department of Agricultural Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

2. Materials and Methods

The present experiments were conducted under field conditions in Randomized Block Design (RBD) and in the laboratory in a Completely Randomized Design (CRD) with fifteen cotton cultivars as treatments replicated thrice during 2010-11 and 2011-12. The cotton cultivar plots were randomized and were maintained during both the years. The crop was fertilized as per the university recommendations.

2.1 The experiment

Thirteen *G. hirsutum* and two *G. arboreum* cultivars were included in the experiment for the study. The seeds of cotton cultivars were sown at cultivar wise recommended plant spacing on the research farm of Cotton Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The crop was raised by following recommended agronomic practices of the university. A recommended dose of nitrogen, phosphorous and potassium was given, respectively as 30:30:30 kg per ha for hirsutum and 20:20:20 kg per ha for arboreum at sowing; and 30:00:00 kg ha for hirsutum and 20:00:00 kg per ha for arboreum a month after sowing, respectively. All other intercultural operations were done as per the university recommendation and due care was taken to maintain proper growth of the crop without any insecticidal spray. The crop was grown in unprotected condition. Observation on major sucking pest *viz.*, aphid, leafhopper, whitefly and thrips on top, middle and bottom leaf per plant recorded from 45 and 60 days after emergence. Five plants were taken for recording pests observations in each plot. Major nutrients *viz.*, nitrogen, phosphorous, potassium, crude in leaves of selected cotton cultivars were estimated at 45 and 60 days after emergence.

2.2 Collection and preparation of samples for analysis

The healthy plants were selected for collecting the samples from the plots of cotton cultivars. The leaves were clipped off at 45 and 60 days after emergence, dried and crushed to powder. The dried crushed leaves of each cultivar were powdered separately in grinding mill so as to pass through 60 mesh size. The powdered material was used for estimation of nitrogen, phosphorus and potassium.

2.3 Estimation of nutrients

2.3.1 Nitrogen

Total nitrogen was determined by digesting the plant sample in microprocessor based digestion system using conc. H_2SO_4 and salt mixture (Piper, 1966) [5] and distillation with automatic distillation system.

2.3.2 Estimation of Phosphorus

Total phosphorus was estimated from di-acid extract by Vanadomolybdate phosphoric acid yellow color method (Kitson and Mellon, 1944) [6] using UV based double beam spectrophotometer.

2.3.3 Estimation of Potassium

Total potassium was estimated from di-acid extract by using flame photometer (Piper, 1966) [5]. The data on major nutrient in various cultivars were analyzed in CRD after appropriate transformation for test of significance (Gomez and Gomez, 1984) [7]. Data on sucking pests was correlated with major nutrient. The mean of 45 and 60 DAE data of sucking pest and major nutrient data both years were considered for simple correlation.

3. Results and Discussion

3.1 Major nutrients in cotton leaves

3.1.1 Nitrogen in cotton leaves

The percentage of nitrogen during 2010-11 (Table 1) in cotton leaves at 45 DAE varied from 2.96 to 3.60 in DHY-286 and RCH-2Bt, respectively. The least nitrogen i.e. 2.96 per cent was in DHY-286 followed in PKV HY-2, AKA-8, AKA-7, PKV Rajat and NHH-44 with 2.98, 3.02, 3.05, 3.07 and 3.27 per cent, respectively and these were at par with each other. The maximum nitrogen per cent was in RCH-2 Bt (3.60%) BNBt (3.60%) followed in RCH-2 (3.53), LRA-5166 (3.52%), Bunny Bt (3.50), KDCH-9632 Bt (3.50), Bunny (3.43), KDCH-9632 (3.43) and NHH-44 Bt (3.36) being at par with each other. The nitrogen content 60 days after emergence varied from genotype to genotype with maximum in RCH-2 Bt (3.59%) and this was statistically similar with nitrogen per cent in BNBt (3.58), RCH-2 (3.52), LRA-5166 (3.49), Bunny Bt. (3.47), KDCH-9632 Bt (3.47), KDCH-9632 (3.40) and NHH-44 Bt (3.34). Bunny and NHH-44 were the next genotypes having nitrogen 3.25 per cent each. The least nitrogen was noted in DHY-286 (2.93) followed in PKV HY-2 (2.95) and these genotypes were at par with AKA-7 (2.98), AKA-8 (3.03) and PKV Rajat (3.06).

Nitrogen percentage during 2011-2012 at 45 DAE (Table 1) varied in cultivar to cultivars. Higher nitrogen was noted in leaves of RCH-2 Bt (3.68%) followed with 3.63, 3.60, 3.59, 3.54, 3.53, 3.48, 3.45,, 3.41 and 3.37 per cent, respectively in BNBt, LRA-5166, RCH-2, Bunny Bt, KDCH-9632 Bt, Bunny, KDCH-9632, NHH-44 Bt and NHH-44 and these cultivars were at par with each other. DHY-286 noted least nitrogen i.e. 2.97 per cent followed by 3.06, 3.06, 3.16 and 3.20 in PWHY-2, PKV Rajat, AKA-8 and AKA-7, respectively; the latter two were at par with nitrogen in NHH-44 and NHH-44 Bt. Genotype RCH-2 Bt was having maximum nitrogen i.e. 3.67% at 60 DAE and this was followed by 3.62, 3.59, 3.57, 3.53, 3.51, 3.47, 3.43 and 3.40%, respectively in BN Bt, LRA-5166, RCH-2, Bunny Bt, KDCH-9632 Bt, Bunny, KDCH-9632 and NHH-44 Bt; however these cultivars being at par with each other. DHY-286 noted least nitrogen with 2.96 per cent followed in PKVHY-2, PKV Rajat, AK-8 and AKA-7 with 3.04, 3.05, 314 and 3.20 per cent, respectively and these did not differ statistically.

Table 1: Nitrogen (%) in cotton leaves (2010-11, 2011-12 and pooled mean).

Tr. No.	Cotton cultivars	Nitrogen (%)					
		2010-2011		2011-2012		Pooled Mean	
		45 DAE	60 DAE	45 DAE	60 DAE	45 DAE	60 DAE
T-1	PKV HY-2	2.98	2.95	3.058	3.05	3.02	3.01
T-2	NHH-44	3.27	3.25	3.37	3.36	3.32	3.30
T-3	NHH-44 Bt	3.36	3.34	3.41	3.40	3.38	3.37
T-4	BN Bt	3.60	3.58	3.63	3.62	3.62	3.60
T-5	RCH-2	3.53	3.52	3.59	3.57	3.56	3.55
T-6	RCH-2 Bt	3.60	3.59	3.68	3.67	3.64	3.63

T-7	Bunny	3.43	3.25	3.48	3.47	3.46	3.36
T-8	Bunny Bt	3.50	3.47	3.54	3.53	3.52	3.50
T-9	KDCH-9632	3.43	3.40	3.45	3.43	3.44	3.42
T-10	KDCH-9632 Bt	3.50	3.47	3.53	3.51	3.51	3.49
T-11	LRA-5166	3.52	3.49	3.60	3.59	3.56	3.54
T-12	DHY-286	2.96	2.93	2.97	2.97	2.97	2.95
T-13	PKV Rajat	3.07	3.06	3.07	3.06	3.07	3.06
T-14	AKA-8	3.05	3.03	3.16	3.14	3.10	3.09
T-15	AKA-7	3.02	2.98	3.20	3.20	3.11	3.09
	SE(m) +	0.104	0.104	0.112	0.112	0.098	0.083
	CD at 5%	0.317	0.315	0.337	0.335	0.297	0.251
	CV (%)	5.45	5.47	5.73	5.68	5.07	4.30

The pooled mean data presented in Table 1 indicted that significantly highest nitrogen at 45 DAE was in RCH-2 Bt (3.64%) followed by 3.62, 3.56 and 3.56 per cent in BNBt, RCH-2 and LRA-5166, respectively and these were at par with Bunny Bt (3.52), KDCH-9632 Bt (3.51), Bunny (3.46), KDCH-9632 (3.44) and NHH-44 Bt (3.38); latter was at par with NHH-44 (3.32). Significantly minimum of 2.96 per cent nitrogen was noted in DHY-286 followed in PKVHY-2 (3.01), PKV Rajat (3.07), AKA-8 (3.10) and AKA-7 (3.11) and these nitrogen percentages were at par with each other and later three were at par with nitrogen in NHH-44. The significantly utmost nitrogen at 60 DAE was noted in RCH-2 Bt (3.63%) followed in BN Bt (3.60%) and these two cultivars were at par with nitrogen in RCH-2 (3.55%), LRA-5166 (3.54%), Bunny Bt (3.50%), KDCH-9632 Bt (3.49%) and KDCH-9632 (3.41%). The NHH-44 Bt, Bunny and NHH-44 were the next cultivars recording 3.37, 3.36 and 3.30 per cent nitrogen, respectively. DHY-286 noted significantly lowest amount of nitrogen i.e. 2.93 per cent followed by 3.00 per cent in PKVHY-2 and nitrogen in these two cultivars were at par with nitrogen in PKV Rajat (3.05%), AKA-7 (3.09%) and AKA-8 (3.09%); however latter two cultivars were at par with NHH-44.

3.1.2 Phosphorous in cotton leaves

During 2010-11, highest phosphorous at 45 DAE (Table 2) was recorded in genotype AKA-8 (0.388%) followed in DHY-286 (0.385%), AKA-7 (0.378%), PKV Rajat (0.376%), PKVHY-2 (0.375%), LRA-5166 (0.365%) and NHH-44 (0.351%). The minimum (i.e. 0.306) was observed in RCH-2 Bt followed by BN Bt, Bunny Bt, Bunny, RCH-2, KDCH-9632 Bt, NHH-44 Bt and KDCH-9632 with 0.309, 0.312, 0.317, 0.319, 0.323, 0.329 and 0.332 per cent, respectively. Similar trend 60 days after emergence was noted. Maximum of 0.381 per cent phosphorous noted in AKA-8 and it was at par with DHY-286, AKA-7, PKV Rajat, PKVHY-2, LRA-5166, NHH-44 noting 0.377, 0.369, 0.367, 0.356, and 349 per cent, respectively and phosphorous in these cultivars was at par to each other and the later two being at par with KDCH-9632 (0.327%), NHH-44 Bt (0.318), KDCH-9632 Bt (0.316%) and RCH-2 (0.312). The least phosphorus was noted in BNBt (0.299%); however it was statistically similar with 0.301, 0. 305, 0.309, 0.312, 0.316, 0.318 and 0.327 per cent recorded in cultivars RCH-2 Bt, Bunny Bt, Bunny, RCH-2, KDCH-9632 Bt, NHH-44 Bt and KDCH-9632, respectively Data on phosphorous during 2011-12 presented in table 2 indicated that the highest phosphorous 45 DAE was found in cultivar DHY-286 (0.368%) and it was at par to AKA-7, PKV Rajat, AKA-8, LRA-5166, PKVHY-2 and NHH-44 in phosphorus content and last being at par with remaining cultivars. The least phosphorous was noted in RCH-2Bt with 0.302 per cent phosphorous which was statistically similar to KDCH-9632 Bt, Bunny Bt, RCH-2, Bunny, BNBt, KDCH-9632, NHH-44 and NHH-44 with 0.308, 0.308, 0.310, 0.312, 0.312, 0.317, 0.325 and 0.343 per cent recorded, respectively.

The data on phosphorous at 60 DAE and the mean of phosphorous 45 and 60 DAE were non-significant. The mean of two seasons phosphorous estimated 45 DAE (Table 2) indicated that the highest of 0.377 per cent phosphorous was observed in DHY-286 it was statistically at par with 0.373 (AKA-8), 0.370 (AKA-7), 0.368 (PKV Rajat), 0.365 (PKVHY-2), 0.362 (LRA-5166) and 0.347 (NHH-44) per cent. The phosphorous in NHH-44 was at par with the phosphorous in rest of the cultivars under study. The least phosphorous was seen in RCH-2 Bt (0.304%) followed in Bunny Bt (0.310%), BN Bt (0.311%), RCH-2 (0.315%), Bunny (0.315%), KDCH-9632 Bt (0.316%), KDCH-9632 (0.324%) and NHH-44 Bt (0.327%). Similar was the trend 60

Table 2: Phosphorous (%) in cotton leaves (2010-11, 2011-12 and pooled mean).

Tr. No.	Cotton cultivars	Phosphorous (%)					
		2010-11		2011-12		Pooled Mean	
		45 DAE	60 DAE	45 DAE	60 DAE	45 DAE	60 DAE
T-1	PKV HY-2	0.375	0.367	0.356	0.341	0.365	0.354
T-2	NHH-44	0.351	0.349	0.343	0.336	0.347	0.343
T-3	NHH-44 Bt	0.329	0.318	0.325	0.320	0.327	0.319
T-4	BN Bt	0.309	0.299	0.314	0.309	0.311	0.304
T-5	RCH-2	0.319	0.312	0.310	0.302	0.315	0.307
T-6	RCH-2 Bt	0.306	0.301	0.302	0.301	0.304	0.301
T-7	Bunny	0.317	0.309	0.312	0.310	0.315	0.310
T-8	Bunny Bt	0.312	0.305	0.308	0.306	0.310	0.306
T-9	KDCH-9632	0.332	0.327	0.317	0.318	0.324	0.323
T-10	KDCH-9632 Bt	0.323	0.316	0.308	0.305	0.316	0.311
T-11	LRA-5166	0.365	0.356	0.358	0.348	0.362	0.352
T-12	DHY-286	0.385	0.377	0.368	0.357	0.377	0.367
T-13	PKV Rajat	0.376	0.369	0.359	0.349	0.368	0.359
T-14	AKA-8	0.388	0.381	0.359	0.352	0.373	0.366

T-15	AKA-7	0.378	0.370	0.361	0.348	0.370	0.359
	SE(m) +	0.017	0.018	0.017	0.017	0.016	0.013
	CD at 5%	0.052	0.053	0.050	-	0.050	0.038
	CV (%)	8.58	9.05	8.64	8.82	8.41	6.61

DAE with maximum of 0.37 per cent phosphorous was noted in DHY-286. It was followed by 0.37, 0.36, 0.36, 0.35, 0.35 and 0.34 per cent noted in AKA-8, AKA-7, PKV Rajat, PKV HY-2, LRA-5166 and NHH-44, respectively; later two being at par with KDCH-9632 (0.32%). The minimum of 0.30 per cent phosphorous was noted in RCH-2 Bt which does not differ statistically than 0.30, 0.31, 0.31, 0.31, 0.31, 0.32, 0.32 and 0.34 per cent noted in BNBt, Bunny Bt, RCH-2, Bunny, KDCH-9632 Bt, NHH-44 Bt, KDCH-9632 and NHH-44, respectively. Ahmad and Manzoor (1981) [8] reported high percentage of phosphorous ranging 1.70 to 1.73 per cent. They observed highest of 1.73 per cent phosphorous in cotton genotypes B557 and MNS 79 and least of 1.70 in MS39 and MS84**.**

3.1.3 Potassium in cotton leaves

The highest of 1.603 percent potassium 45 DAE during 2010-11 (Table 3) was noted in DHY-286 and it was followed with 1.673, 1.663, 1.660, 1.657,1.653 and 1.647 per cent estimated in LRA-5166, PKV Rajat, KDCH-9632, KDCH-9632 Bt Bunny and Bunny Bt and all these were at par with each other. The least potassium was found in cultivar AKA-8(1.597%) and it was at per with potassium in cultivars *viz.*, AKA-7 (1.603), RCH-2 Bt (1.6139), RCH-2 (1.617%) PKV HY-2 (1.623%), NHH-44 (1.630%) and NHH-44 Bt (1.633%). The potassium estimated 60 days after emergence ranged between 1.603 and 1.687 per cent with maximum in DHY-286. However, it was statistical similar to 1.677 (LRA-5166), 1.667 (KDCH-9632) and PKV Rajat), 1.660 (Bunny and KDCH-9632 Bt) and 1.650 (NHH-44 Bt and Bunny Bt) per cent. The cultivar AKA-8 was having least of 1.603 per cent potassium which was at par with 1.607, 1.617, 1.620 and 1.640 per cent noted in AKA-7, RCH-2 Bt, RCH-2 and PKVHY-2, respectively.

The data of 2011-12 presented in table 3 indicted that the potassium 45 days after emergence were ranging from 1.610 to 1.683 per cent. The highest amount of potassium (1.683%) per cent was found in cultivar LRA-5166 and it was followed by 1.68 (DHY-286), 1.67 (KDCH-9632, KDCH-9632 Bt and PKV Rajat), 1.66 (Bunny Bt), 1.66 (Bunny) and 1.65 (BN Bt.) percent and all these cultivar were at par of each other. The minimum of 1.610% potassium was noted in AKA-8 however it was at par with 1.613 (AKA-7), 1.617 (RCH-2 Bt), 1.620 (RCH-2) and 1.640 percent (PKV HY-2 and NHH-44) which was being at par with each other. The potassium content in leaves varied from cultivar to cultivar at 60 DAE. The highest percentage of 1.683 was noted in cultivar DHY-286 which being on par with potassium 1.673 (KDCH-9632 and LRA-5166), 1.670 (PKV Rajat), 1.663 (KDCH-9632 Bt) 1.657 (NHH-44 Bt, Bunny, Bunny Bt) and 1.653 (BNBt) per cent. The least potassium has noted in AKA-7 (1.613%) followed in AKA-8 (1.617%) RCH-2 Bt (1.620%), RCH-2 (1.623%) PKV HY-2 (1.643%) and NHH-44 (1.647%) and all there were at par to each other.

Table 3: Potassium (%) in cotton leaves (2010-11, 2011-12 and pooled mean).

Tr. No.	Cotton cultivars	2010-11		2011-12		Pooled Mean	
		45 DAE	60 DAE	45 DAE	60 DAE	45 DAE	60 DAE
T-1	PKV HY-2	1.623	1.640	1.640	1.643	1.632	1.642
T-2	NHH-44	1.630	1.643	1.640	1.647	1.635	1.645
T-3	NHH-44 Bt	1.633	1.650	1.647	1.657	1.640	1.653
T-4	BN Bt	1.643	1.647	1.653	1.653	1.648	1.650
T-5	RCH-2	1.617	1.620	1.620	1.623	1.618	1.622
T-6	RCH-2 Bt	1.613	1.617	1.617	1.620	1.615	1.618
T-7	Bunny	1.653	1.660	1.657	1.657	1.655	1.658
T-8	Bunny Bt	1.647	1.650	1.660	1.657	1.653	1.653
T-9	KDCH-9632	1.660	1.667	1.670	1.673	1.665	1.670
T-10	KDCH-9632 Bt	1.657	1.660	1.667	1.663	1.662	1.662
T-11	LRA-5166	1.673	1.677	1.683	1.673	1.678	1.675
T-12	DHY-286	1.683	1.687	1.677	1.683	1.680	1.685
T-13	PKV Rajat	1.663	1.667	1.667	1.670	1.665	1.668
T-14	AKA-8	1.597	1.603	1.610	1.617	1.603	1.610
T-15	AKA-7	1.603	1.607	1.613	1.613	1.608	1.610
	SE(m) +	0.012	0.011	0.011	0.012	0.008	0.005
	CD at 5%	0.036	0.034	0.032	0.035	0.024	0.016
	CV (%)	1.24	1.17	1.12	1.22	0.84	0.57

The pooled mean range of potassium (Table 3) at 45 DAE was 1.603 and 1.680 per cent. The highest amount of potassium (1.680%) was noted in DHY-286 which was at par to 1.678 (LRA-5166) 1.665 (KDCH-9632 and PKV Rajat) and 1.662 (KDCH-9632 Bt) per cent later one being at par to potassium in Bunny (0.655%) Bunny Bt. (1.653%) BN Bt. (1.648%) and NHH-44 Bt(1.640%). The least amount of potassium was found in AKA-8 which was statistically similar to potassium in AKA-7 (1.608%) RCH-2 Bt (1.615%) and RCH-2 (1.618%) however later two being at par potassium 1.632 and 1.635 per cent noted in PKV HY-2 and NHH-44, respectively. The pooled mean potassium 60 days after cultivars ranged between 0.610 and 1.685 per cent. The maximum potassium was found in DHY-286 and it was followed in LRA-5166 (1.675%) and KDCH-9632 (1.670) and was at par to each other. The later was statistically similar to PKV Rajat, KDCH-9632 Bt and Bunny recording 1.668, 1.662 and 1.658 per cent potassium respectively. The minimum of 1.610 per cent potassium was found in AKA-7 and AKA-8 followed in RCH-2 Bt (1.618%) and RCH-2

(1622%) and there were at par to each other. The cultivars viz, NHH-44 Bt. Bunny Bt, BN Bt., NHH-44 and PKV HY-2 were noted 1.653, 1.653, 1.653, 1.650, 1.645 and 1.642 per cent potassium, respectively.

3.2 Correlation of major nutrients and sucking pests

The correlation coefficients presented in table 4 of sucking pests and plant nutrient constituents were calculated on basis of mean of 45 and 60 DAE two years pooled data.

3.2.1 Nitrogen

Nitrogen had high association with leaf hopper population built up (table 4). Nitrogen had highly significant positive correlation with leaf hopper population indicating increased nitrogen content in leaves favors the development of leaf hoppers. However, aphid, thrips and whitefly populations established positive but non-significant correlation with nitrogen. It is believed that increased nitrogen in the plant nutrition can change the plant quality and also reduce the plant's resistance against aphids in cotton and similarly to this (Godfrey *et al.*, 1999) [9]. Lu *et al*., (2007) [10] reported that Nitrogen is one of the most important factors in the development of herbivore populations. Bi *et al*., (2003) [11] in another study observed a positive response between Nitrogen application rates and the numbers of adult and immature whiteflies appearing during population peaks. These findings partially confirm the results obtained by Hassan *et al*. (2000) [12] who tested five cotton cultivars for their relative resistance against sucking pets and reported a positive correlation of nitrogen with whitefly, *B. tabaci* (Genn.).

Table 4: Correlation of major sucking pests and biochemical constituents in cotton leaves.

Biochemical	Aphids	Leafhoppers	Thrips	Whitefly
Nitrogen	0.090	0.717**	0.174	0.009
Phosphorous	-0.060	-0.774**	-0.245	-0.063
Potassium	0.063	-0.104	0.397*	0.730**
N= 30	r = 0.361 (5%)	r = 0.463 (1%)		

3.2.2 Phosphorous

Potassium has been considered a key component of plant nutrition that significantly influences crop growth and some pest infestation (table 4). Phosphorous had a highly significant negative impact (r, -0.774) on leaf hoppers indicates the higher is the phosphorous least will be the leaf hoppers. Whereas, aphids, thrips and whiteflies were not influenced significantly with level phosphorous in leaves. The application of phosphorus reduced the population densities and damage of pod sucking bug reports Pitan *et al*., (2000) [13].

3.2.3 Potassium

The thrips population (r =0.397) and whitefly adult population (r=0.730) was affected significantly and positively by potassium content (table 4). These findings partially confirm the results obtained by Hassan *et al*. (2000) [12] who tested five cotton cultivars for their relative resistance against sucking pets and reported a positive correlation of potassium with whitefly, *B. tabaci* (Genn.).

However, Jayaswal and Pundarikakshudu (1987) [14] noted no definite trends in the N, P and K contents of the leaves of cotton lines, susceptible and resistant to whitefly. In *G. hirsutum* leaf Rao *et al*. (1990) [15] observed higher contents of K, P and lower N in whitefly *B. tabaci* (Genn.) resistant genotypes as compared in susceptible ones. The development and survival of cotton leafhopper was studied on 12 host plant species including cotton in relation to biochemical *viz*., total phenol, tannin, potassium, calcium, moisture at Hissar by Sharma and Singh (2001) [16] and reported that none of the leaf phytochemical found significant relationship with biological parameters of leafhopper.

4. Conclusions

The major nutrients viz., nitrogen, phosphorous and potassium play a vital role for growth and development of the crop plants. The uptake rate of nutrients from soil by cotton plant varies from cultivar to cultivar. The cotton plant cultivars respond differently against sucking pests. Nitrogen had high association with leaf hopper population built up; increased nitrogen content in leaves favors the development of leaf hoppers. Aphid, thrip and whitefly population build up development less influences with nitrogen content; increased nitrogen concentration in leaves less favors growth of aphids, thrips and whiteflies. Increased phosphorous levels in leaves suppress the growth and development of leaf hoppers and express its negative role. Aphids, thrips and whiteflies show less response to phosphorous in leaves. Potassium has been considered a key component of plant nutrition that significantly influences crop growth and some pest infestation. Increased leaf potassium content preferred by thrips and whitefly adult population for their development.

5. References

1. Ahmad M, Arif MI, Ahmad Z, Denholm I. Cotton whit fly (*Bemicia tabaci*) resistance to organophosphate and pyrethroid insecticides in Pakistan, Pest Management Sci. 2002; 58:203-208.
2. Nelson MR, Nadeem A, Ahmad W, Orum TV. Global assessment of cotton viral diseases. In Proc. Belt wide Cotton Conf., San Diego, CA 5-9 Jan 1998, Natl. Cotton Counc. Am., Memphis, T.N, 1998, 161-162.
3. Pawar UM, Kadam JR. Entomological aspects of IPM in important crop Maharashtra State. State level conference on IPM, 1995, 20-40.
4. Hopkins WG, Huner NPA. Introduction to plant physiology, John Wiley and Sons Inc. USA. 2004, 479-481.
5. Piper CS. Soi and Plant Analysis. Hans Publishers, Bombay, 1966.
6. Kitson RE, Mellon MG. Calometric Determination of phosphorous as molybdophosphoric acid, Ind. Eng. Chemstry Ed. 1944; 16:379-383.
7. Gomez KA, Gomez AA. Statistics for Agriculture Researc, 2nd Edn. John Wiley and Sons, New York, 1984.
8. Ahmad Nazir, Manzoor UH. Some studies on resistance in cotton against jassid *Amrasca devastans* (Distant) and whitefly *Bemicia tabaci* (Genn.), Pakistan Entomologist. 1981; 3(1, 2):29-34.
9. Godfery LD, Keillor K, Hutmacher RB, Cisneros JJ. Interaction of cotton aphid population dynamics and cotton fertilization regime in California. Cotton Proceeding Belt wide Cotton Conference, Orlando,

Florida, USA. 1999; 2:1008-1011.
10. Lu Z, Yu X, Kong-luen H, Hu C. Effect of nitrogen fertilizer on herbivores and its stimulation to major insect pests in rice. Rice Science. 2007; 14(1):56-66.
11. Bi JL, Toscano NC, Madore MA. Effect of urea fertilizer application on soluble protein and free amino acid content of cotton petioles in relation to silver leaf whitefly, *Bemisia argentifolii* populations, J Chemical Ecology. 2003; 29(3):747-761.
12. Hasan M, Ahmad F, Wakeel Waqas. Role of biochemical components in varietal resistance of cotton against sucking insect pests. Pakistan Entomologist. 2000; 22(1, 2):69-71 Record Number 20053117168.
13. Pitan ORO, Odebiyi JA, Adeoye GO. Effects of phosphate fertilizer on cowpea pod-sucking bug population and damage, Int. J. Pest Management. 2000; 46:205-209.
14. Jayaswal AP, Pundarikakshudu R. Evaluation some cotton germplasam for their resistance to whitefly *Bemicia tabaci* (Genn.). Proc. Biennial Workshop, AICCIP, Hyderabad, 1987.
15. Rao NV, Reddy AS, Ankaioh R, Rao YN, Khasim SM. Incidence of whitefly (*Bemicia tabaci*) in relation to leaf characters of upland plant cotton, (*Gossypium hirsutum*), Indian J Agric. Sci. 1990; 60:619-624.
16. Sharma A, Singh R. Survival and development of cotton leafhopper, *Amrasca bigutula bigutula* (Ishida) in relation to some biochemical and morphological characteristics on plants, J. Cotton Research Development, 2001; 15(2):191-195.