

Seasonal and Genotypic Influence on Insect Pests, Growth and Yield of Cowpea (*Vigna unguiculata* L. Walp)

Abstract

Cowpea (*Vigna unguiculata* L. Walp) is rich in dietary protein and a relish in most West African countries. Unfortunately, a substantial part of cowpea cultivation comes from the drier northern regions. Four elite genotypes (IT 97K-499-35, IT 97K-568-18, IT 98K-131-2 and IT 93K-452-2) emanating from the breeding programme of International Institute of Tropical Agriculture (IITA), Ibadan were therefore evaluated for their relative adaptations to a rainy season environment. A local variety was added as a check. The accessions were laid out in a randomized complete block design (RCBD) in two seasons (early and late) for two years (2009 and 2010) at DEMACCO Integrated Farms Ltd., AKO, Enugu state, Nigeria. The result revealed the presence of genotype x season interaction. Reproductive grain yield and insect damage on the crop differed significantly ($p < 0.05$) between genotypes and/or season. Pod weight, 100-seed weight, grain weight, threshing percentage and harvest index of the late crop increased by 31%, 25%, 72%, 71% and 41% respectively over that of the early. Late season grain yields of IT 93K-131-2 (1177.0 kg ha⁻¹) and IT 93K-452-1 (1121.0 kg ha⁻¹) were outstanding compared to other genotypes and seasons and were more tolerant to pre-and post flowering insect pest. The early season grain yields of IT 93K-452-1 (1000.02 kg ha⁻¹) and IT 97K-499-35 (987.00 kg ha⁻¹) were comparable to their respective late season yields (1121.00 kg ha⁻¹ and 898.22 kg ha⁻¹ respectively). Prevalence of pod sucking bugs and thrips were more evident on the late crops than on the early, while the reverse was the case for aphid, *Maruca* and *Ootheca* counts. Bruchid populations were not affected by seasonal varieties.

Key words: adaptation, genotype x season, harvest index, insect damage, threshing percentage.

32

33 **Introduction**

34 Cowpea, *Vigna unguiculata* L. Walp is an important protein rich source. It is
 35 cultivated on at least 12.5 million hectares with an annual production of over 3 million tonnes
 36 world wide (APS, 2008). The plant is widely distributed throughout the tropics, but Central
 37 and West Africa accounts for over 64% of the area. In West Africa, a substantial part of the
 38 cowpea production comes from the drier regions of northern Nigeria (Singh *et al.*, 1997).
 39 Southern Nigeria, unfortunately accounted for only about 0.5% of the total production and
 40 0.38% of the total area cultivated in Nigeria in 2007(APS, 2008). In other words, cowpea at
 41 present is predominantly a crop of drier areas.

42 Quin (1997) noted that as further advances are made in crop improvement and
 43 management, there will be opportunities for production of cowpea in longer season wetter
 44 agro ecologies. Low productivity of cowpea in this region was attributed mainly to lack of
 45 access to improved varieties, high incidence of insect pests, poor crop management and high
 46 humidity (Singh *et al.*, 2002).

47 Insect pest damage constitutes a major constraint to cowpea production in Nigeria
 48 (Amatobi, 1994). Use of insecticide improves yield of cowpea tenfold (Parl, 1993). But the
 49 effect of misuse of insecticide is already being felt as more cases of resistance and damage to
 50 ecosystems are being reported yearly (Adalla, 1994). To increase the efficiency of
 51 insecticides and reduce overuse, it is pertinent that chemical application should be integrated
 52 with other cultural practices especially those involving manipulation of the environment
 53 (Kamara *et al.*, 2009). Pest problems in cowpea can also be reduced through the use of
 54 method that change or modifies the pest habitat and interferes with the insect's identification
 55 of and responses to, its host plant (Tahvanainen and Root, 1972). The choice of crops has

56 been govern primarily by the crop's contribution to diets and substance rather than their
57 effects in insect control. The identification of cultivar (s) that produce reasonable yield
58 without insecticidal protection can be a low input approach to solving the problem of yield
59 constraint occasioned by high population of insect pests and also enhance sound, ecologically
60 and economically viable cowpea production options. Furthermore, the integration of low
61 input genotypes with seasonal variations will even result in more sustainable cowpea
62 production system through better IPM strategy lending credence to G X E (Genotype x
63 Environment Interaction) impact.

64 The presence of G X E interaction indicates that the genotype might be superior to another
65 genotype in one environment but inferior in a different environment (Falconer and Mackay,
66 1996). Crop yield and performance fluctuates due to suitability of varieties to different
67 growing seasons and conditions brought about by environmental stresses such as insect pests.
68 Knowledge of the G X E interaction is therefore important in selecting new varieties that will
69 catalyze the commercialization of the variety production enterprise by medium and large
70 scale farmers.

71 In view of the foregoing therefore, this study was aimed at selecting cowpea genotype
72 (s) that could be adaptable in areas of rainfall without significant devastation by insect pests.
73 The general objective of this study is to assess the productivity of some newly bred
74 accessions of cowpea from International Institute of Tropical Agriculture (IITA) under
75 varying seasons in a moist derived savanna area of southeastern Nigeria.

76 **The Specific Objectives:**

- 77 i. To assess the effect of cropping seasons on the growth and yield of different cowpea
78 genotype.
- 79 ii. To assess the effect of seasonal variation on major insect pest of cowpea in the field.

80 **Materials and Method**

81 The experiment was carried out at the DEMACCO Integrated Farms Ltd., Ako, Nike
 82 Enugu (06° 34' N; 07° 35' E; 154 m asl) in Enugu state; Nigeria in 2009 and 2010. The soil of
 83 the experimental sites had low percentage sand (28% in 2009 and 23% in 2010) and
 84 moderately high silt content (13% in 2009; 39% in 2010) and therefore of moderately high
 85 moisture retention (Table 1). The cation exchange capacity (12 meq/100 g soil in 2009; 20
 86 meq/100 g soil in 2010), organic carbon and organic matter contents were 0.19% and 0.33%
 87 respectively in 2009 and 2.57% and 4.42% respectively in 2010. Also the total nitrogen,
 88 phosphorus, base saturation and exchangeable calcium contents were 0.042%, 10.26%,
 89 23.58% and 1.8 meq/100 g soil respectively in 2009 and 0.154%, 13.06 ppm, 33.35% and 4.2
 90 meq/100g soil respectively in 2010. The rainy seasons which varies between May and
 91 October of each years is bi-modal with highest monthly rainfall occurring between the
 92 months of June and September (Table 2). Temperature ranged from 28°C to 34°C in both
 93 years. The lowest temperature was experienced from July to September and rises steadily
 94 from October to March. Conversely, the relative humidity followed a reverse order with
 95 temperature and highest relative humidity occurring from July to September and decreasing
 96 gradually from October to May with the lowest being experienced between January and
 97 March.

98 The experimental plot was ploughed, harrowed and manually ridged. Prior to ridging, a basal
 99 dose of 100 kg NPK 15-15-15 per hectare plus 1000 kg per hectare of well curred cow dung
 100 was broadcast uniformly and later incorporated into the soil before ridging. In each of the two
 101 planting seasons (early and late), the experiment was laid out in a randomized complete block
 102 design (RCBD) with three replications. Four elite genotypes (IT 97K-499-35, IT 97K-568-18,
 103 IT 98K-131-2 and IT 93K-452-2) emanating from the breeding programme of IITA were

104 used. A local variety was added to serve as a control. The characteristics of the accessions
105 used are as shown in table 3

106 Seeds were dressed with fungicide, “seed plus”^(R) (Imidacloprid 10% + Metalaxyl
107 10% + Carbendazim 10%) at the rate of 10 g to 2 kg cowpea seed. Each plot consisted of 4
108 rows of cowpea of 2-m long. Inter-row spacing was 75-cm with an intra-row spacing of 25-
109 cm. Three seeds were planted per hole at 3-5-cm depth but later thinned down to two stands
110 per hill 14 days after planting (DAP). Weeds were manually controlled as regularly as they
111 appear, while other agronomic practices were duly observed. Data were collected from the
112 two inner rows in each plot on days to 50% flowering, days to maturity, number of pods per
113 plant, pod weight, fresh and dry fodder weight, 100-seed weight, pod length, number of seeds
114 per pod, grain yield per hectare, threshing percentage and harvest index. The threshing
115 percentage was calculated as:

$$\left(\frac{\text{Grain weight}}{\text{pod weight}} \times 100 \right)$$

116

117 While the harvest index (HI) was estimated as:

$$\left(\frac{\text{Economic Yield (grain yield)}}{\text{Biological yield (fodder yield)}} \times 100 \right)$$

118

119 For the entomological data, five flowers were picked 100 days after planting (DAP)
120 from each plot during the morning hours (6.00 hrs-9.00 hrs) and put in vials containing 30%
121 alcohol. The flower samples were later dissected and the number of flower thrips
122 (*Megalurothrips sjostedti*) and *Maruca* larval (*Maruca vitrata*) determined. Pod sucking bugs
123 (*Clavigralla tomentosicollis* and *C. shadabi*) were counted in the two middle rows when the
124 insects were observed in the field. *Ootheca mutabilis* and cowpea aphids (*Aphis craccivora*)

were scored on a scale of 1-5, where 1= no sign of damage, 2 = 25% damage, 3=50% damage, 4 = 75% damage and 5 = 100% damage (Amatobi, 1994). Bruchids (*Callosobruchus maculatus*) damage was determined three months after harvest. For the bruchid assessment, 100 grains were randomly sampled from each plot lot and enclosed in a paper bag of similar material type and kept in a room under room temperature. The bruchid damage was determined by counting the number of bruchid holes on 50 randomly selected grains from each lot.

Statistical Analysis

Data collected for the two years (2009 and 2010) were later pooled before subjecting them to analysis of variance (ANOVA) using GENSTAT Discovery Edition 2 (GENSTAT, 2005) as outlined for RCBD. Insect counts and damage percentages were normalized using appropriate transformation procedure before analysis of variance was carried out on them. Means were compared using Fisher's least significant difference (F-LSD).

Results

Seasonal effects were obtained on the reproductive and grain yield components of the cowpea genotypes (Table 4). Respective genotypes sown during the late season significantly ($p<0.05$) flowered earlier and took longer days to fill their pods compared with those sown during early in the season. Late season sown genotypes also resulted in 25% higher mean 100-seed weight, 31% higher mean pod weight, 71% higher mean seed weight, 72% higher mean grain yield, 25% higher mean threshing percentage and 41% higher mean harvest index relative to early season grown genotypes. On the other hand, early season genotypes produced 23% higher mean pod length than late season genotypes.

147 With respect to the grain yield, genotypes IT 93K-452-1 and IT 97K-499-35
148 significantly ($p<0.05$) produced higher grain yield compared to other early season planted
149 genotypes, while genotypes IT 98K-131-2 and IT 93K-452 -1 in the late season significantly
150 ($p<0.05$) outperformed other genotypes irrespective of season. Meanwhile, seasonal
151 variations depressed 100-seed weight in genotype IT 93K-452-1 from 16 g in early season to
152 14 g in the late season and the number of pods per plant from 32 in early season to 24 in late
153 season. On the other hand, IT 97K-499-35, IT 97K-568-18 and IT 98K-131-2 exhibited
154 similar performance for 100-seed weight in both seasons. Local being photo-sensitive could
155 not flower during the early season as expected while it produced significantly ($p<0.05$) lower
156 grain yield than other genotypes in the late season. Local varieties however, expressed
157 significantly higher seed weight (18 g) over the rest of the genotypes in the late season. Mean
158 pod length was affected by season as late season drastically reduced pod length in all the
159 genotypes but worse on IT 97K-499-35.

160 Seasonal changes also affected most genotypes with respect to threshing percentage
161 and harvest index. This is such that early season depressed the threshing percentage and
162 harvest index in genotype IT 97K-568-18 by 22.9% and 47.1% respectively, relative to the
163 genotypes during the late season. Genotypes IT 97K-568-18 and IT 98K-131-2 were mostly
164 affected as their harvest indices were significantly ($p<0.05$) reduced in early season.

165 Counts of aphids, *Maruca* and *Ootheca* sampled from the respective genotypes in the
166 early season were higher than their corresponding late season genotypes (Table 5). On the
167 average, mean populations of aphids, *Maruca* and *Ootheca* were 113%, 182% and 47%
168 respectively higher in early than in the late season. Conversely, the corresponding scores and
169 counts of the pod sucking bugs and thrips sampled from the genotypes in the late season were
170 significantly ($p<0.05$) higher than their corresponding early season genotypes. On the
171 average, the presence of the bugs and thrips were respectively higher by 43% and 60% in the

172 late season over those of the early season. Population difference of the bruchids between
173 early and late season did not differ appreciably. However, early season local variety
174 harboured no bruchid, *Maruca* pod sucking bug or thrips during the season.

175

176 Discussion

177 Seasonal variations (early and late) were utilized to evaluate some selected cowpea
178 genotypes. Yield and yield components were found to be higher in the late than in the early
179 season planted cowpea. The better performance of the crops in the late season was seen to be
180 due to better solar radiation, higher leaf area index and lower aphid and *Maruca* pressures on
181 the crops within the season. Similar results were obtained by Ezedinma, (1967); Karungi *et al.*
182 (2000) and Javid *et al.* (2005), which they attributed to higher solar radiation and leaf area
183 index as well as lower pest pressures. In our study, rainfall, temperature and relative humidity
184 differed slightly in the two seasons. The late season cropping experienced relatively
185 remarkable reductions in rainfall and increase in temperature during the pod maturation
186 stages. This slightly higher rainfall in the early over the late season could have contributed to
187 the increased pest (aphids and *Maruca*) population during early relative to the late season.

188 Seasonal variation basically had significant effects on cowpea flowering. The non-
189 photosensitive genotypes flowered and produced grain yields and yield components as
190 expected in both seasons, while local failed to flower or produce grain yield in the early
191 season planting owing to its sensitivity to photoperiods. This result is in conformity with the
192 findings of Singh *et al.* (2002); Kamara *et al.* (2009). The photoperiodic response of the
193 genotypes consequently explains the shorter days to flowering observed in the late season
194 crops. This is in agreement with Summerfield and Robert (1985) thesis which reported that
195 warmer temperatures hasten the appearance of flowers irrespective of their photoperiodic
196 responses. Most of the local cowpea cultivars in Nigerian savanna belt are photoperiod
197 sensitive and have indeterminate growth habits. They are late maturing and very susceptible
198 to pests and disease (Amatobi, 1995). As photoperiod shortens towards the end of the rainy
199 season (September-October) in West Africa, these adaptive features ensure timely flowering
200 of land race germplasms (Wein and Summerfield, 1980).

201 The local variety recorded significantly lower yield and yield components in late
202 season. This is supported by Singh and Ajeigbe (2001) who revealed that the actual grain
203 yield obtainable in farmers farm in West Africa sub-region are very low (25-300 kg ha⁻¹) due
204 to severe attacks from extensive pest complex and use of unimproved varieties.

205 The population of aphids was found to be generally low but higher in early than late
206 season. Our finding is similar to that of Blade and Singh (1994) who also observed lower
207 aphid populations in southern Nigeria. They reported that aphids occurred throughout the
208 year because groundnut, cowpea and other leguminous hosts were always available. This
209 result is further supported by Bottenberg *et al.* (1997), who observed that aphids are present
210 all the year round but predominates during the early season in the south and dry season in the
211 North. The high population of aphids in late season reported by researchers in Northern
212 Nigeria was attributed to the fact that the crop is grown in Northern Nigeria in a farming
213 system with other susceptible host crops like groundnut which is dominated in that region.

214 Seasonal variation did not affect bruchid infestation in our study; however, accessions
215 IT 97K-499-35 and IT 98K-452-1 significantly harboured higher pest loads in all the seasons.
216 Although IITA claimed that some of the genotypes used in this study are bruchid resistance,
217 our finding did not confirm their claim in all cases except IT 90K-277-2 that was stable for
218 this trait in all seasons. It was also found that *Maruca* pest was considerably lower in late
219 season in all the genotypes than in the early season. This result is similar to the finding of
220 Alghali (1991), which reported very low infestation levels of *Maruca* in the season. *Maruca*
221 is a migratory pest which moves from south to North over a period of several months or
222 generations following pattern of leguminous crops and rainfall. This movement of legume
223 cultivation from south to north following the northward programme of rainfall also could
224 account for the lower infestation of this pest recorded during the late season.

225 It was also found that pod sucking bugs were prevalent in the location used for this
 226 study with higher population in the late than early season. Local and IT 93K-452-1 were
 227 more infested by pod sucking bugs than the rest of the improved genotypes. The findings of
 228 Javid *et al.* (2005) and Kamara *et al.* (2010) are in support of our result that pod sucking bugs
 229 attacked cowpea more in late than early season but at variance with Adalla (1994), who
 230 reported that pod sucking bug infestations were always higher in early than late season. The
 231 two varieties (local and IT 97K-452-1) found to harbour more pod sucking bugs in our study
 232 are late maturing and possess large seed size. Jackai and Adalla (1994) reported that several of
 233 the newly identified resistant germplasm that are resistant to pod sucking bugs have small
 234 seed size. They concluded that seed size was directly related to damage by the bugs. *Ootheca*
 235 population was found to be low in this study. Also genotypic variation was not prominent
 236 with respect to *Ootheca* count. The population of thrips was found to be higher than other
 237 post-flowering pests implicating thrips as one of the most important pest of cowpea in West
 238 Africa savanna. This result is in agreement with Alghali (1992) who reported thrips as the
 239 most prevalent insect pests of cowpea in southern Guinea and Sudan savanna agro-ecological
 240 zone in Nigeria. Amatobi (1995) identified thrips as the most limiting insect pest in terms of
 241 grain yield loss.

242 Generally, the late season grown cowpea performed better than the early season
 243 grown crops. However, performance of accessions IT 97K-499-35 and IT 93K-452-1 grown
 244 in the early season compared favorably with such crops grown during the late season. There
 245 was no appreciable difference in the harvest indices and threshing percentages of the crops in
 246 the two seasons. Again, damage on the two accessions (IT 97K-499-35 and IT 93K-452-1)
 247 and by the bugs and thrips were lower during the early than the late season, which was the
 248 reverse with aphid, bruchids and *Maruca*.

In conclusion, accession IT 97K-499-35 and IT 93K-452-1 appeared to be more tolerant to rainy (wetter) conditions than others accessions and therefore, could be recommended for planting during the rainy seasons of the year in this locality.

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333 **Table 1: Soil Physical and Chemical Properties of the Experiment Sites**

Soil Properties	Ako	
	2009	2010
Clay (per cent)	12	18
Silt (per cent)	13	39
Fine sand (per cent)	47	20
Coarse sand (per cent)	28	23
Texture class	Sandy loam	Loamy
Chemical properties		
pH in water	6.0	5.6
pH in KCL	5.1	4.9
Organic carbon (per cent)	0.19	2.57
Organic matter (per cent)	0.33	4.42
Total nitrogen (per cent)	0.042	0.154
Total phosphorus (per cent)	10.26	13.06
Base saturation (per cent)	23.58	33.35
Exchangeable bases in meq/100g soil		
Sodium	0.38	0.51
Potassium	0.05	0.16
Calcium	1.8	4.2
Magnesium	0.6	1.8
CEC	12.0	20.0

Table 2: Rainfall (mm), temperature (⁰C) and relative humidity (percent) of the study sites.

Year	Variable	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov	Dec.	Total	Mean
2009	Rainfall	53.6	2.2	0.0	180.6	283.7	152.4	248.2	260.3	175.8	387.1	103.2	0.0	1847.1	153.9
	Temperature	32.0	33.0	34.0	32.0	30.0	29.0	29.0	28.0	28.0	28.0	30.0	33.0	—	31
	Rel. humidity	71.0	73.0	73.0	76.0	74.0	75.0	75.0	75.0	75.0	75.0	64.0	65.0	—	73
2010	Rainfall	0.0	0.0	43.9	161.8	212.3	247.4	158.5	404.2	204.0	183.6	19.3	0.0	1635	136.3
	Temperature	33.0	34.0	34.0	33.0	30.0	29.0	28.0	28.0	28.0	29.0	30.0	32.0	—	31
	Rel. Humidity	67.0	72.0	71.0	73.0	74.0	76.0	77.0	77.0	77.0	76.0	74.0	61.0	—	73

Table 3: The origin and description of genotypes used in this study.

Genotype	Origin	Photo-sensitivity	Maturity	Growth habit	100 seed weight (g)	Seed Coat colour	Seed texture
IT 98k-131-2	IITA	NPS	Medium	Prostrate, indeterminate	16	Brown	Rough
IT 97k-568-18	IITA	NPS	Medium	Prostrate, indeterminate	16	Brown	Rough
IT 97k-499-35	IITA	NPS	Early	Semi-Prostrate, determinate	16	white	Rough
IT 93k-452-2	IITA	NPS	Early	Semi-prostrate, determinate	17	white	Rough
Local Check	Landrace	PS	Late	Prostrate, indeterminate	17	White	Rough

NPS-Non-Photosensitive

PS-Photosensitive

Table 4: Effect of season and genotypes on reproductive and grain yield components of 5 cowpea genotypes combined over 2009 and 2010.

Season	Genotype	DFWT (g)	FFWT (g)	Bloom (days)	Maturity (days)	Pod fill (days)	100SWT (g)	NPOD/PLT	NSEED/POD	PODLT (cm)	PODWT (kg)	SEED WT (kg)	GYLD/Ha (kg)	THRESH (%)	HI (%)
Early	IT 97K-499-35	1117.0	7850.0	43.73	63.88	20.00	14.77	24.98	11.46	19.21	418.66	296.10	987.00	69.88	50.75
	IT 97K-568-18	1692.0	11615.0	47.54	71.08	24.03	13.98	21.23	11.29	16.00	95.40	54.92	183.12	54.42	5.51
	Local	1383.0	10092.0	-	-	-	-	-	-	-	-	-	-	-	-
	IT 98K-131-1	1617.0	10625.0	47.46	69.63	23.00	14.06	25.08	13.57	15.53	185.33	123.22	411.00	69.07	11.66
	IT 93K-452-1	858.0	5692.0	39.65	62.33	23.09	15.46	31.67	10.71	13.98	416.70	300.00	1000.02	70.30	65.18
	Mean	1333	9175.0	44.60	66.73	23.00	11.78	20.82	9.47	16.00	223.20	154.90	516.00	52.73	26.62
Late	IT 97K-499-35	846.0	3154.0	39.23	61.75	23.24	14.04	20.10	11.96	14.33	364.73	269.43	898.22	73.30	34.41
	IT 97K-568-18	493.0	1772.0	43.96	65.69	28.16	14.60	29.56	11.92	14.00	299.00	226.67	754.64	69.78	39.25
	LOCAL	783.0	2741.0	50.56	76.00	30.00	17.73	33.62	9.42	11.01	233.70	141.30	470.90	74.55	15.10
	IT 98K-131-2	708.0	2308.0	43.31	66.10	26.00	14.92	25.19	12.27	13.75	468.70	353.20	1177.00	73.55	54.46
	IT 93k-452-1	758.0	2733.0	34.23	60.00	26.00	14.19	23.54	10.58	12.00	458.20	336.40	1121.09	73.90	48.07
	Mean	718.0	2542.0	42.26	65.91	27.00	15.10	26.40	11.23	13.00	364.90	265.40	885.00	65.46	38.26
	F-LSD (0.05)	169.3	1079.4	2.47	3.26	3.17	1.29	4.62	0.95	2.25	51.37	39.49	131.60	3.16	7.94

Bloom Days to 50 percent flowering; MATURITY = Days of maturity; PODFILL; 100SWT=100 seed weight; NPOD/PLT = number of pods per plant; NSEED/POD = Number of seeds per pod; PLENGHT = Pod length; PODWT = pod weight; SEEDWT = seed weight; GYLD/HA = Grain yield per hectare; THRESH percent = Threshing percentage; HI = Harvest index.

Table 5: Effect of season and genotypes on insect damage of 5 cowpea genotypes combined over 2009 and 2010 in Ako.

SEASON	GENOTYPE	APHISC	BRUCHIDCT	MARCT	OOTHESC	PSBSC	THRIPCT
Early	IT 97K-499-35	2.65	45.60	5.54	1.25	1.00	6.29
	IT 97K-568-18	2.25	15.20	3.68	1.63	1.10	6.42
	Local	1.06	-	-	1.92	-	-
	IT 98K-131-2	2.69	15.30	3.94	1.58	1.00	6.87
	IT 93K-452-1	3.49	50.20	7.52	1.33	0.98	7.27
	Mean	2.51	31.58	4.13	1.54	0.95	5.37
Late	IT 97K-499-35	0.94	43.40	1.50	1.06	1.29	8.62
	IT 97K-568-18	1.23	18.30	1.48	1.04	1.33	10.56
	Local	1.10	40.30	1.12	1.10	1.63	14.23
	IT 98K-131-2	0.96	14.90	1.73	1.06	1.33	9.73
	IT 93K-452-1	1.44	40.60	1.46	10.00	1.44	11.67
	Mean	1.13	31.50	1.46	1.05	1.40	10.96
	F-LSD _(0.05)	1.94	8.82	2.74	0.20	0.23	3.22

APHIDSC = Aphid score; BRUCHICT = Bruchid count; MARUCT = *Maruca* count; OOTHESC = *Ootheca* score; PSBSC = Pod Sucking Bug score; THRIPCT = Thrips count.