

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). Cowpea is not widely
41 cultivated in any rainy condition. It is not necessary to tell the total cultivated area. Inspite of
42 the importance of cowpea as a protein rich food, it is still more cultivated on drier regions.
43 Quin (1997) noted that as further advances are made in crop improvement and management,
44 there will be opportunities for production of cowpea in longer season wetter agro ecologies.
45 Low productivity of cowpea in this region was attributed mainly to lack of access to
46 improved varieties, high incidence of insect pests, poor crop management and high humidity
47 (Singh *et al.*, 2002).

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

of and responses to, its host plant (Tahvanainen and Root, 1972). The choice of crops has been govern primarily by the crop's contribution to diets and substance rather than their effects in insect control. The identification of cultivar (s) that produce reasonable yield without insecticidal protection can be a low input approach to solving the problem of yield constraint occasioned by high population of insect pests and also enhance sound, ecologically and economically viable cowpea production options. Furthermore, the integration of low input genotypes with seasonal variations will even result in more sustainable cowpea production system through better Integrated Pest Management (IPM) strategy lending credence to G X E (Genotype x Environment Interaction) impact.

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

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

The Specific Objectives:

- i. To assess the effect of cropping seasons on the growth and yield of different cowpea genotype.

80 ii. To assess the effect of seasonal variation on major insect pest of cowpea in the field.

81 **Materials and Method**

82 The experiment was carried out at the DEMACCO Integrated Farms Ltd., Ako, Nike Enugu
 83 (06° 34' N; 07° 35' E; 154 m asl) in Enugu state; Nigeria in 2009 and 2010. The experimental
 84 plot was ploughed, harrowed and manually ridged. Prior to ridging, a basal dose of 100 kg
 85 NPK 15-15-15 per hectare plus 1000 kg per hectare of well curred cow dung was broadcast
 86 uniformly and later incorporated into the soil before ridging. Two sowing dates (early and
 87 late seasons) were observed for 2009 and 2010 with early sowing date in June 18, while late
 88 sowing was in August 30. In each of the two planting seasons (early and late), the experiment
 89 was laid out in a randomized complete block design (RCBD) with three replications. Four
 90 elite genotypes (IT 97K-499-35, IT 97K-568-18, IT 98K-131-2 and IT 93K-452-2)
 91 emanating from the breeding programme of IITA were used. A local variety was added to
 92 serve as a control. The characteristics of the accessions used are as shown in table 3

93 Seeds were dressed with fungicide, “seed plus”^(R) (Imidacloprid 10% + Metalaxyl
 94 10% + Carbendazim 10%) at the rate of 10 g to 2 kg cowpea seed as recommended by the
 95 manufacturers. Each plot consisted of 4 rows of cowpea of 2-m long. Inter-row spacing was
 96 75-cm with an intra-row spacing of 25-cm. Three seeds were planted per hole at 3-5-cm
 97 depth but later thinned down to two stands per hill 14 days after planting (DAP). Weeds were
 98 manually controlled as regularly as they appear, while other agronomic practices were duly
 99 **observed** followed. Data were collected from the two inner rows in each plot on days to 50%
 100 flowering, days to maturity, number of pods per plant, pod weight, fresh and dry fodder
 101 weight, 100-seed weight, pod length, number of seeds per pod, grain yield per hectare,
 102 threshing percentage and harvest index. The threshing percentage was calculated as:

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

103

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

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

105

106 For the entomological data, five flowers were picked 100 days after planting (DAP)
 107 from each plot during the morning hours (6.00 hrs-9.00 hrs) and put in vials containing 30%
 108 alcohol. The flower samples were later dissected and the number of flower thrips adults
 109 (*Megalurothrips sjostedti* Trybom) and *Maruca* larvae (*Maruca vitrata* Geyer) determined.
 110 Pod sucking bugs (*Clavigralla tomentoscicollis* Stal. and *C. shadabi* Dolling) were counted in
 111 the two middle rows when the insects were observed in the field. *Ootheca mutabilis* Schonher
 112 and cowpea aphids (*Aphis craccivora* Koch) were scored on a scale of 1-5, where 1= no sign
 113 of damage, 2 = 25% damage, 3=50% damage, 4 = 75% damage and 5 = 100% damage
 114 (Amatobi, 1994). Bruchids (*Callosobruchus maculatus* Fabricius) damage was determined
 115 three months after harvest. For the bruchid assessment, 100 grains were randomly sampled
 116 from each plot lot and enclosed in a paper bag of similar material type and kept in a room
 117 under at room temperature. The bruchid damage was determined by counting the number of
 118 bruchid holes on 50 randomly selected grains from each lot.

119 **Statistical Analysis**

120 Data collected for the two years (2009 and 2010) were later pooled as there was no
 121 significant year effect before subjecting them to analysis of variance (ANOVA) using
 122 GENSTAT Discovery Edition 2 (GENSTAT, 2005) as outlined for RCBD. Insect counts and
 123 damage percentages were normalized using appropriate transformation procedure before
 124 analysis of variance was carried out on them. Means were compared using Fisher's least
 125 significant difference (F-LSD) at 5%.

126

127 **Results**

128 . The soil of the experimental sites had low percentage sand (28% in 2009 and 23% in
 129 2010) and moderately high silt content (13% in 2009; 39% in 2010) and therefore of
 130 moderately high moisture retention (Table 1). The cation exchange capacity (12 meq/100 g
 131 soil in 2009; 20 meq/100 g soil in 2010), organic carbon and organic matter contents were
 132 0.19% and 0.33% respectively in 2009 and 2.57% and 4.42% respectively in 2010. Also the
 133 total nitrogen, phosphorus, base saturation and exchangeable calcium contents were 0.042%,
 134 10.26%, 23.58% and 1.8 meq/100 g soil respectively in 2009 and 0.154%, 13.06 ppm,
 135 33.35% and 4.2 meq/100g soil respectively in 2010. The rainy seasons which vary between
 136 May and October of each **years** year is bi-modal with highest monthly rainfall occurring
 137 between the months of June and September (Table 2). Temperature ranged from 28⁰C to
 138 34⁰C in both years. The lowest temperature was experienced from July to September and
 139 rises steadily from October to March. Conversely, the relative humidity followed a reverse
 140 order with temperature and highest relative humidity occurring from July to September and
 141 decreasing gradually from October to May with the lowest being experienced between
 142 January and March.

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

149 early season grown genotypes. On the other hand, early season genotypes produced 23%
150 higher mean pod length than late season genotypes.

151 With respect to the grain yield, genotypes IT 93K-452-1 and IT 97K-499-35
152 significantly ($p<0.05$) produced higher grain yield compared to other early season planted
153 genotypes, while genotypes IT 98K-131-2 and IT 93K-452 -1 in the late season significantly
154 ($p<0.05$) outperformed other genotypes irrespective of season. Meanwhile, seasonal
155 variations depressed 100-seed weight in genotype IT 93K-452-1 from 16 15.46 g in early
156 season to 14 14.19 g in the late season and the number of pods per plant from 32 31.67 in
157 early season to 24 23.54 in late season. On the other hand, IT 97K-499-35, IT 97K-568-18
158 and IT 98K-131-2 exhibited similar performance for 100-seed weight in both seasons. Local
159 being photo-sensitive could not flower during the early season as expected while it produced
160 significantly ($p<0.05$) lower grain yield than other genotypes in the late season. Local
161 varieties however, expressed significantly higher seed weight (18 17.73 g) over the rest of the
162 genotypes in the late season. Mean pod length was affected by season as late season
163 drastically reduced pod length in all the genotypes but worse on IT 97K-499-35.

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

169 Counts of aphids, *Maruca* and *Ootheca* sampled from the respective genotypes in the
170 early season were higher than their corresponding late season genotypes (Table 5). On the
171 average, mean populations of aphids, *Maruca* and *Ootheca* were 113%, 182% and 47%
172 respectively higher in early than in the late season. Conversely, the corresponding scores and

173 counts of the pod sucking bugs and thrips sampled from the genotypes in the late season were
174 significantly ($p < 0.05$) higher than their corresponding early season genotypes. On the
175 average, the presence of the bugs and thrips were respectively higher by 43% and 60% in the
176 late season over those of the early season. Population difference of the bruchids between
177 early and late season did not differ appreciably. However, early season local variety
178 harboured no bruchid, *Maruca* pod sucking bug or thrips during the season.

179

180 Discussion

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

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

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

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

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

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

Generally, the late season grown cowpea performed better than the early season grown crops. However, performance of accessions IT 97K-499-35 and IT 93K-452-1 grown in the early season compared favorably with such crops grown during the late season. There was no appreciable difference in the harvest indices and threshing percentages of the crops in the **two** both seasons. Again, damage on the two accessions (IT 97K-499-35 and IT 93K-452-1) **and** by the bugs and thrips were lower during the early than the late season, which was the 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 wet) conditions than others other accessions and therefore, could be recommended for planting during the rainy seasons of the year in this locality. However, depending on the period of the year, if some pest species exhibits higher populations, one could be chosen.

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337 **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 ($^{\circ}\text{C}$) 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

DFWT= Dry fruit weight; FFWT= Fresh fruit weight; 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.