197
Annals
Agric. Sci.,
Ain Shams Univ.,
Cairo, 52(1), 197-212, 2007

Screening some Local and Introduced Cowpea Cultivars for Dry-Seed Yield and Resistance to *Callosobruchus maculatus* (F.)

[16]

Obiadalla-Ali, H. A.[1], A.M.A. Salman[2] and M. A.H. Abd El-Hady[3]

1. Department of Horticulture, Faculty of Agriculture, Sohag University., Sohag, Egypt
2. Department of Plant Protection, Faculty of Agriculture, Sohag University., Sohag, Egypt.
3. Horticultural Research Institute, Agricultural Research Center, Giza, Egypt.

Keywords: Cowpea, Cultivars, Yield, Tolerance, *Callosobruchus maculatus*

ABSTRACT

Twenty-one cultivars of cowpea (*Vigna unguiculata* L. Walp) were screened for dry-seed yield and its components during two successive summer seasons (2004 and 2005) under Sohag conditions. There were significant differences among cultivars for all studied characters. Cultivar 'Dokki 331' was the earliest, while cultivar 'IT 81 D-994' was the latest in flowering. Cultivar Black eye stems were the longest, while, those of cultivar 'Dokki 331' were the shortest. Cultivar 'IT 93K 624' produced the longest pods, while cultivar 'IT 81 D-721' the shortest ones. Cultivar 'TVU 21' gave the largest number of branches/plant, while cultivar 'IT 90 K 1020-6' was the least in this character. Cultivar 'IT 81 D-1064' gave the greatest number of seeds/pod, while cultivar 'Black eye' was the least in this character. Cultivar 'IT 93 K 2045-20' gave the highest value for pod-filling, while cultivar 'IT 93 K 2046-1' showed the lowest value. Cultivar 'IT 81 D-994' produced the highest weight of 100-seeds, while those seeds of cultivar 'IT 81 D-721' were the lowest. Cultivar 'IT 93 K 12904' produced the highest total dry-seed yield, while cultivar 'IT 81 D-994' gave the lowest.

In addition, the twenty-one cultivars of cowpea were tested and screened for susceptibility to infestation by *Callosobruchus maculatus* (F.) in the laboratory condition. Results obtained for the cowpea seed beetle (*C. maculatus*) indicated a different response of the tested cultivar seeds in terms of preference and non preference, laid eggs, percentage of damaged seeds and emerges adults, developmental period, adult weight at emergence and seed weight loss due to feeding by one larva when reared on seeds of the same cultivars. Cultivars IT 81 D-1064, IT 93 K 12904 and IT 82 D-889 showed a significant degree of antixenosis, antibiosis and/or tolerance to infestation by *C. maculatus*. These cultivars had few numbers of eggs laid by one *C. maculatus* female, low percentages of damaged seeds, loss in weight and emerged adults. The total developmental time (TDT) of this pest was significantly delayed when reared on these cultivars. Also, larvae consumed less amount of their seed material. Also, the body weight of adults reared from these cultivars was less when compared with those reared on most of the other cultivars. Therefore, these four cultivars may be useful for breeding programs of cowpeas towards producing new cultivars with high level of resistance/tolerance to *C. maculatus*.

It was concluded that the cultivar IT 93K 12904 Produced the highest total dry seed yield and was the most tolerant to *C. maculates*.

INTRODUCTION

Cowpea (*Vigna unguiculata* L. Walp) is one of the most important legume crops in Egypt and

(Received Marh 12, 2007)
(Accepted April 14, 2007)

tropical and sub-tropical regions. Improving crop productivity as well as resistance to cowpea weevil insect in Egypt may be achieved through introducing new high-yielding and resistant cultivars. Several investigators in different countries of the World carried out evaluation studies of cowpea cultivars and/or genotypes. In Egypt, many cultivars of cowpea were tested and evaluated by **Abdel-Salam & El-Hakeem (1970); Malash (1971); Stino *et al* (1971); Nassr (1981); Abdel-Ati (1983); Abo-Baker *et al* (1983); Gamil & Gad El-Hak (1984); Gad El-Hak *et al* (1988) and Damarany (1994).** In International Institute of Tropical Agriculture (IITA) in Nigeria, cowpea trials were carried out by **Akinola and Davis (1978); Summerfild *et al* (1978), Aggarwal (1987); Blade *et al* (1992) and Singh (1993).** Studies of cowpea varietal evaluation were also carried out in other countries of the World by many investigators, **(Farish, 1947; Ojehomon, 1979; Kohli *et al* 1971; Bliss *et al* 1973; Chandrappa, 1974; Erksin & Khan, 1976; Chaturvedi *et al* 1980; Turk *et al* 1980; Bobytatha *et al* 1984; Fernandez & Miller 1985; Kahn & Stojelia, 1985; Singh & N'tare, 1985; Davis *et al* 1986; Apte *et al* 1987; Babaleye, 1988; Paul *et al* 1988; Akundabweni *et al* 1989; N'tare, 1989; Aghora *et al* 1994; Kormawa *et al* 2004; Kristjanson *et al* 2005 and Alene & Manyong 2006**). These authors found considerable variation among cowpea cultivars and breeding lines. In addition, cowpea is a stable legume seed that is important worldwide **(Singh & Van Emden, 1979 and Jackai & Daoust, 1986).**

Cowpea provides more than half of the plant protein consumed by many poor people in the tropics and subtropics region and it contributes to animal feed and soil nitrogen environment. However, as in the case of many other food crops, wide spectrums of insect pests attack cowpea both in the field and during storage causing severe economic damage **(Prevelt, 1961 and Caswell, 1981).** Among them is the cowpea beetle, *Callosobruchus maculatus* (F.), a cosmopolitan and most important pest of stored cowpeas **(Jackai and Daoust, 1986)** that can render the unprotected unsusceptible for food or seed in 4-6 months.

Control of this important seed pest is crucial to the sustainable production of cowpea in all the areas where it occurs. While there are several commercial insecticides available for the control of *C. maculatus*, these are often too expensive for low-resource farmers, unavailable in village markets and can also result in food contamination or environmental pollution **(Egwuatu, 1987).** In order to reduce over-dependence on chemicals for control of seed loss due to *C. maculatus* attack, the search for resistant cowpea has increasingly become the option of choice in recent years. The development and use of resistant cowpea cultivars offers a simple, cheep and attractive approach for the reduction of *C. maculatus* damage. Several workers **(Booker, 1967; Redden & McGuire, 1983; Ofuya, 1987 and Mbata, 1993)** have used different combinations of seed and insect numbers to screen the seeds of cowpea for resistance to *C. maculatus*. The success of such screening programs depends very critically on using standardized protocols that are accurate, reliable and generally accepted for measuring resistance. The objective of this study was to screen twenty-one cultivars of cowpea for high-yielding and resistance to weevil insect injury while being acceptable to the Egyptian farmers and consumers.

MATERIALS AND METHODS

Twenty one different cultivars of cowpea (*Vigna unguiculata* L. Walp) from diverse origins were used in this study. The names, seed coat color and sources of these cultivars are presented in **Table (1) and Figure (1)**. These materials were screened for yield, yield component and susceptibility to *Callosobruchus maculatus* (Fabricius). The study was carried out in the Laboratory and Experimental Farm at Sohag University during the two successive summer seasons (2004 and 2005). The soil where the cowpeas were grown is sandy calcareous (top 30 cm surface layer contains transported Nile sediments over desert soil). A Randomized Complete-Block Design (RCBD) with four replications was used. Each plot consisted of four ridges 60 cm wide and 4 m long, the plot area was 9.6 m^2. Seeds were sown in the first week of May in both years at 30 cm within-row spaces. The normal cultural practices of irrigation, fertilization, and weeding and pest control were followed in this study.

Data recorded on cowpea plants were number of days to 50% flowering, length of plant per mater and number of branches per plant. Harvesting was done as about 50%of the pods of each plot dried, then 10 pods were randomly taken from each plot to record pod length, number of seeds per pod, weight of 100 dry seeds, and pod filling % determined according to **Remison (1978)** using

Table 1. Name, source and seed color and size of twenty-one cultivars of cowpea tested in this study.

Code No.	Cultivars	Source	Seed color and Size
1	IT 85 F-2205	IITA *, Ibadan, Nigeria	Orang (large)
2	IT 82 D-889	IITA *, Ibadan, Nigeria	Dark Red (small)
3	IT 81 D-1064	IITA *, Ibadan, Nigeria	Red (small)
4	IT 81 D-721	IITA *, Ibadan, Nigeria	Cream with Black eye (large)
5	TVU 3236	IITA *, Ibadan, Nigeria	Cream with Orange eye (large)
6	IT 81 D-994	IITA *, Ibadan, Nigeria	Cream with Broun eye (large)
7	IT 93 K 2045-20	IITA *, Ibadan, Nigeria	Cream with Black eye (large)
8	IT 93 K 273-201	IITA *, Ibadan, Nigeria	Cream with Black eye (large)
9	IT 93 K 12904	IITA *, Ibadan, Nigeria	Cream with Black eye (small)
10	IT 90 K 1020-6	IITA *, Ibadan, Nigeria	Cream with Red eye (large)
11	IT 93 K 370	IITA *, Ibadan, Nigeria	Cream with Black eye (large)
12	IT 89K D 374-57	IITA *, Ibadan, Nigeria	Cream with Orang eye (large)
13	IT 93K 624	IITA *, Ibadan, Nigeria	Cream with Red eye (large)
14	IT 90 K 2840-2	IITA *, Ibadan, Nigeria	Cream with Sora Black (large)
15	IT 98 K 2064-2	IITA *, Ibadan, Nigeria	Cream with Black eye (large)
16	IT 93 K 2046-1	IITA *, Ibadan, Nigeria	Orange (large)
17	Blackeye	IITA *, Ibadan, Nigeria	Cream with Black eye (large)
18	TVU 21	IITA *, Ibadan, Nigeria	Cream with bid Red eye (large)
19	Black Crowder	IITA *, Ibadan, Nigeria	Dark Black (large)
20	Creamy 7	Local, EAO**, Egypt	Creamy with cream eye (large)
21	Dokki 331	Local, EAO**, Egypt	Creamy with black eye (large)

* IITA, International Institute of Tropical Agriculture, Ibadan, Nigeria.
** EAO, Egyptian Agricultural Organization, Egypt.

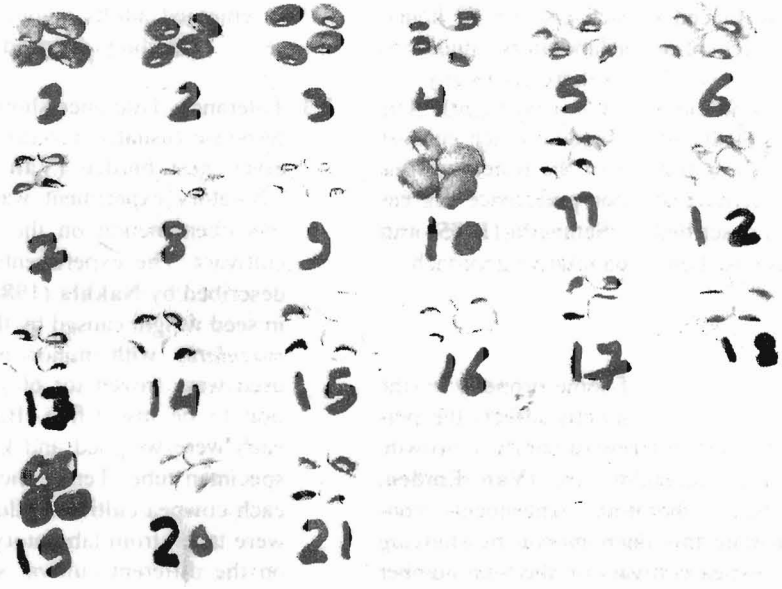


Figure 1. Dry seeds of twenty-one cowpea cultivars. (1) IT 85 F-2205. (2) IT 82 D-889. (3) IT 81 D-1064. (4) IT 81 D-721. (5) TVU 3236. (6) IT 81 D-994. (7) IT 93 K 2045-20. (8) IT 93 K 273-201. (9) IT 93 K 12904. (10) IT 90 K 1020-6. (11) IT 93 K 370. (12) IT 89K D 374-57. (13) IT 93K 624. (14) IT 90 K 2840-2. (15) IT 98 K 2064-2. (16) IT 93 K 2046-1. (17) Blackeye. (18) TVU 21. (19) Black Crowder. (20) Creamy 7. (21) Dokki 331.

the following formula: Pod-filling % = No. of seeds per pod / Pod length (cm) x100.

In addition, total yield of dry seeds was recorded

As for seed susceptibility to cowpea weevil (*Callosobruchus maculatus*), the following steps were conducted:

1- Stock Culture

A laboratory culture of *Callosobruchus maculatus* (Fabricius) was established from the naturally infested cowpea seeds and maintained for three generations under laboratory conditions. The seeds were first deep frozen for 30 days to kill off any prior infestation and were then kept under laboratory conditions for 7 days before infestation.

2- Preference and non preference test

Choice tests were conducted according to **Messina and Renwick (1985)** to examine beetle oviposition preference among the 21 cowpea cultivars. Each choice test consisted of four Petri dishes supplied with 25 seeds and replicated four times to each cultivar. Four males and females of the newly emerged adults (0-12 hour old) of *C. maculatus* were placed in each dish for 72 hours. Petri dishes were kept under laboratory conditions at temperature of 31 ± 2°C, relative humidity 55-60% and photoperiod of 16/8 (day/night). The number of eggs laid on the seeds of each cultivar was recorded. Classification of the tested cowpea cultivars to preference and non preference degrees was applied as described by **Semeada (1985) and Nosser (1996)** based on a quantitative approach.

3- Antibiosis

Antibiosis is position of some property by the plant which directly or indirectly affects the performance of the pest in terms of survival, growth, development rate, fecundity, etc **(Van Emden, 1987).** Therefore, laboratory experiments conducted to elucidate this phenomenon by studying the effect of cowpea cultivars on the total number of emerged adults and the biology of *C. maculatus* as devised by **Ofuya (1987)** with minor modifications where necessary.

3.1. Effect of cowpea cultivars on the total number of emerged adults: Forty clean seeds of each cultivar were submitted for infestation by one male and one female of *C. maculatus* obtained from the laboratory cultivar. New emerged adults (0-24 hour old) were used. Infestation was in 9.0 cm diameter glass Petri dishes. Four Petri dishes were infested per cultivar to give four replications. The Petri dishes were kept under laboratory conditions at a temperature of 31± 2, relative humidity of 55/60 % and photoperiod of 16/8 (day/night). The percentages of damage were recorded 30 days after infestation. Additionally, 40 seeds weight of 40 clean seeds of each cowpea cultivar were determined. The percentage of damaged seeds was calculated as number of damaged seed / Total number of damaged and undamaged seed.

3.2. Effect of cowpea cultivars on the biology of *C. maculates*: Forty clean seeds of each cultivar were infested with one fresh adult male and female (0/24 hour old) in glass Petri dishes (9.0 cm diameter). The insects added were reared on the same cowpea cultivars. The developmental period (egg laying to adult emergence) was observed for adults emerging from each cowpea cultivar. Also, the fecundity and longevity of female reared from each cultivar were calculated. The percentage of adults emerged was calculated as total number of emerged adults / number of eggs laid on seeds including hatched and non-hatched eggs.

3.3. Tolerance: Tolerance show as a reduced plant response (usually in terms of yield loss) to a given pest burden **(Van Emden, 1987).** A laboratory experiment was illustrated to test this phenomenon on the 21 studied cowpea cultivars. The experiments was conducted as described by **Nakhla (1988)** to determine loss in seed weight caused by the cowpea beetle *C. maculatus* with minor modification. Seeds used were frozen for 60 days before infestation to be insect-free. Batches of ten seeds each were weighed and kept in 1.5 x 20 cm specimen tube. Ten replicates were made for each cowpea cultivar. Adults of *C. maculatus* were taken from laboratory culture and reared on the different cultivar seeds under laboratory conditions. One pair (male and female) of newly emerged adults was introduced to each specimen tube containing known weight seeds (ten seeds). The tubes were covered with cotton and kept under laboratory condition at a temperature of 31 ± 2°C, relative humidity 55-60 % and photoperiod of 16/8 (day / night).

Seventy-two hours later, the insects were removed and the tubes containing the ten seeds having eggs were again kept at the same experimental conditions and observed daily till emergence of freshly adults. The daily emerging adults were counted and weighed up to the end of the generation. The weight of the ten seeds in each specimen tube was determined. The decrease in weight of ten seeds is equivalent to the amount of food consumed by the larvae of the emerging adults. The weight loss in seeds was determined as follows: weight of seeds before infestation - weight of seeds at end of the storage period. All data in this study obtained were subjected to statistical analysis by using F-test. The means were compared according to Duncan's multiple range Test (**Gomez and Gomez, 1984**).

RESULTS AND DISCUSSION

I- Flowering and vegetative Growth

As shown in **Table (2)**, number of days to reach 50% flowering ranged from 46 to 60.5 day. The earliest cultivar was 'Dokki 331', while the latest one was 'IT 81 D-994'. Similar trend was reported by **Abd El-Hady, (1998)**. Data on plant length show that the tested cultivars significantly differed, some were determinate with small and compact vegetation and others were indeterminate having large vegetation. Plant length ranged from 32.95 to 124.85 cm. Cultivar 'Dokki 331' had the shortest and cultivar 'Black eye' had the longest stems. Results of number of branches/plant are presented in **Table (3)**. A wide range of variation was detected among the tested cultivars. Number of branches/plant ranged from 5.28 ('IT 90 K 1020-6') to 12.52 ('TVU 21').

A wide range of variation was detected among the tested cultivars in respect of pod length **Table (3)**. Pod length ranged from 10.43 to 18.23 cm.

Cultivar 'IT 93 K 624' had the longest pods (18.23 cm), while cultivar 'IT 81 D-721' gave the shortest ones (10.43 cm).

As for number of seeds per pod data in **Table (4)** presented, a wide range of variability among these tested cultivars.

Table 2. Number of days to 50% flowering and plant length (cm) for 21 cultivars of cowpea evaluated during the summer planting in 2004 and 2005 seasons, Sohag, Egypt.

Code No.	Cultivars	Days to 50% Flowering			Plant length (cm)		
		2004	2005	Mean	2004	2005	Mean
1	IT 85 F-2205	54 bc	53 cd	53.5 C	58.4 m	58.5 lm	58.47 K
2	IT 82 D-889	48 h	49 gh	48.5 I	52.4 q	52.3 q	52.33 N
3	IT 81 D-1064	51 ef	50 fg	50.5 GH	60.3 k	60.0 kl	60.17 J
4	IT 81 D-721	54 bc	54 bc	54.0 C	87.0 def	86.3 ef	86.67 E
5	TVU 3236	55 b	55 b	55.0 B	55.9 n	55.2 no	55.57 L
6	IT 81 D-994	60 a	61 a	60.5 A	83.6 g	83.3 g	83.43 F
7	IT 93 K 2045-20	50 fg	51 ef	50.5 GH	48.6 r	48.3 r	48.43 O
8	IT 93 K 273-201	50 fg	50 fg	50.0 H	41.2 s	41.1 s	41.15 P
9	IT 93 K 12904	54 bc	54 bc	54.0 C	49.1 r	48.8 r	48.93 O
10	IT 90 K 1020-6	54 bc	54 bc	54.0 C	98.0 c	98.2 c	98.08 C
11	IT 93 K 370	52 de	51 ef	51.5 EF	79.5 h	79.3 h	79.38 G
12	IT 89K D 374-57	51 ef	51 ef	51.0 FG	59.5 klm	59.3 klm	59.4 JK
13	IT 93K 624	54 bc	53 cd	53.5 C	88.1 d	87.4 de	87.77 D
14	IT 90 K 2840-2	55 b	55 b	55.0 B	103. b	104.0 b	103.50 B
15	IT 98 K 2064-2	53 cd	52 de	52.5 D	53.7 pq	54.0 op	53.83 M
16	IT 93 K 2046-1	51 ef	50 fg	50.5 GH	52.5 q	52.4 q	52.45 N
17	Black eye	53 cd	52 de	52.5 D	124.7 a	125.0 a	124.83 A
18	TVU 21	52 de	52 de	52.0 DE	68.1 j	67.8 j	67.97 I
19	Black Crowder	51 ef	50 fg	50.5 GH	76.7 i	77.0 i	76.83 H
20	Creamy 7	51 ef	51 ef	51.0 FG	85.7 f	86.0 ef	85.83 E
21	Dokki 331	46 i	46 i	46.0 J	32.8 t	33.1 t	32.95 Q
	Mean	52.33 A	52.10 A		69.46 A	69.40 A	

Means within each column followed by the same letter(s) are not significantly different at the 0.05 probability levelII- Yield and its components

Table 3. Pod length and number of branches/plant for 21 cultivars of cowpea evaluated during the summer planting in 2004 and 2005 seasons, Sohag, Egypt.

Code No.	Cultivars	Pod length (cm)			No. of branches /plant		
		2004	2005	Mean	2004	2005	Mean
1	IT 85 F-2205	13.47 jkl	13.80 ij	13.63 G	7.10 ijk	7.07 i-l	7.08 H
2	IT 82 D-889	13.67 ijk	14.00 hij	13.83 FG	7.20 ijk	7.23 ijk	7.22 GH
3	IT 81 D-1064	15.87 d	16.17 cd	16.02 C	9.30 e	9.27 e	9.28 D
4	IT 81 D-721	10.37 q	10.50 q	10.43 L	8.30 gh	8.27 gh	8.28 F
5	TVU 3236	11.97 op	12.30 no	12.13 IJ	8.17 gh	8.50 fg	8.33 F
6	IT 81 D-994	16.27 bcd	16.60 bc	16.43 B	6.27 n	6.60 k-n	6.43 I
7	IT 93 K 2045-20	12.33 no	12.00 op	12.17 IJ	7.67 hi	7.50 i	7.58 G
8	IT 93 K 273-201	14.07 hi	14.43 fgh	14.25 E	7.30 ij	7.20 ijk	7.25 GH
9	IT 93 K 12904	13.93 hij	13.80 ij	13.87 FG	6.37 mn	6.70 j-n	6.53 I
10	IT 90 K 1020-6	14.67 efg	14.97 ef	14.82 D	5.37 o	5.20 o	5.28 J
11	IT 93 K 370	12.27 no	12.60 mn	12.43 I	6.43 lmn	6.30 n	6.37 I
12	IT 89K D 374-57	16.47 bc	16.80 b	16.63 B	6.43 lmn	6.10 n	6.27 I
13	IT 93K 624	18.33 a	18.40 a	18.23 A	6.20 n	6.40 mn	6.30 I
14	IT 90 K 2840-2	13.10 lm	13.20 kl	13.15 H	8.27 gh	8.60 fg	8.43 F
15	IT 98 K 2064-2	11.57 p	11.90 op	11.73 K	7.00 i-m	7.20 ijk	7.10 H
16	IT 93 K 2046-1	18.07 a	18.10 a	18.22 A	6.40 mn	6.60 k-n	6.50 I
17	Black eye	12.13 nop	12.20 no	12.17 IJ	10.67 d	10.80 cd	10.73 C
18	TVU 21	14.93 ef	15.00 e	14.97 D	12.43 a	12.60 a	12.52 A
19	Black Crowder	11.93 op	12.00 op	11.97 JK	8.67 fg	9.03 ef	8.85 F
20	Creamy 7	12.27 no	12.63 mn	12.45 I	11.37 bc	11.70 b	11.53 B
21	Dokki 331	14.10 hi	14.20 ghi	14.15 EF	8.17 gh	8.50 fg	8.33 F
	Mean	13.89 A	14.08 A		7.86 A	7.97 A	

Means within each column followed by the same letter(s) are not significantly different at the 0.05 probability level.

Table 4. Number of seeds/pod and pod filling percent for 21 genotypes of cowpea evaluated during the summer planting in 2004 and 2005 seasons, Sohag, Egypt.

Code No.	Cultivars	No. of seeds/pod			Pod filling %		
		2004	2005	Mean	2004	2005	Mean
1	IT 85 F-2205	10.80 ghi	11.00 efg	10.90 D	80.20 c	79.71 c	79.96 CD
2	IT 82 D-889	10.00 k-p	10.13 j-m	10.1 EFG	73.17 ef	72.40 efg	72.79 FG
3	IT 81 D-1064	12.43 ab	12.60 a	12.52 A	78.43 cd	77.93 cd	78.18 D
4	IT 81 D-721	8.17 uv	8.23 uv	8.20 K	78.78 cd	78.43 cd	78.60 CD
5	TVU 3236	10.50 hij	10.93 fgh	10.72 D	88.01 b	88.87 b	88.44 B
6	IT 81 D-994	11.27 ef	11.40 de	11.33 C	69.30 ghi	68.68 g-j	68.99 H
7	IT 93 K 2045-20	12.03 bc	11.80 cd	11.92 B	97.64 a	98.34 a	97.99 A
8	IT 93 K 273-201	10.10 j-n	10.17 j-m	10.13 FF	71.85 efg	70.48 fgh	71.17 GH
9	IT 93 K 12904	10.47 ijk	10.27 jkl	10.37 E	75.12 de	74.40 e	74.76 E
10	IT 90 K 1020-6	12.00 bc	12.07 bc	12.03 B	81.77 c	80.62 c	81.20 C
11	IT 93 K 370	9.93 l-p	10.07 j-o	10.00 FG	80.99 c	79.95 c	80.47 CD
12	IT 89K D 374-57	10.80 ghi	10.90 f-l	10.85 D	65.61 ijk	64.88 jk	65.25 I
13	IT 93K 624	12.10 bc	12.00 bc	12.05 B	66.99 h-k	65.24 jk	66.11 I
14	IT 90 K 2840-2	8.40 tu	8.40 tu	8.40 K	64.13 k	63.64 k	63.88 I
15	IT 98 K 2064-2	9.27 qr	9.63 n-q	9.45 I	80.12 c	80.95 c	80.53 CD
16	IT 93 K 2046-1	9.83 l-p	9.73 m-p	9.78 GH	53.63 l	53.77 l	53.70 J
17	Black eye	7.73 w	7.90 vw	7.82 I	63.75 k	64.75 k	64.25 I
18	TVU 21	9.87 l-p	10.00 k-p	9.93 FG	66.08 ijk	66.67 ijk	66.37 I
19	Black Crowder	8.77 st	8.90 rs	8.83 J	73.47 ef	74.17 ef	73.82 EF
20	Creamy 7	10.00 k-p	10.20 j-m	10.1 EFG	81.53 c	80.74 c	81.14 C
21	Dokki 331	9.53 pq	9.60 opq	9.57 HI	71.64 efg	71.39 efg	71.51 FG
	Mean	10.19 A	10.28 A		74.39A	74.10A	

Means within each column followed by the same letter(s) are not significantly different at the 0.05 probability level.

Number of seeds/pod ranged from 7.82 to 12.52 seeds.

Cultivar 'IT 81 D-1064' had the largest number of dry seeds/pod (12.52), while cultivar 'Black eye' had the smallest number of dry seeds/pod (7.82). Pod length and number of seeds/pod were reported to be positively associated with seed yield. Cultivars having higher values for pod length and number of seeds/pod are favorable. The results of variability in both traits (pod length and number of dry seeds/pod) were in agreement with those obtained by **Stino *et al* (1971); Nasser (1981); Kahn & Stofelia (1985) and Gad El-Hak *et al* (1988).**

Concerning pod filling percent a wide range of variability was found among the studied cultivars (53.70 to 97.99 %) as presented in **Table (4).** The highest value of pod filling was obtained from cultivar 'IT 93 K 2045-20'. On the other hand, cultivar 'IT 93 K 2046-1 had the lowest value of pod filling. Similar trends were reported by **Turk *et al* (1980); Fernandez & Miller (1985) and Aggarwal (1987).**

Among the important yield components in cowpea is the weight of 100 dry-seeds. Results of this trait are presented in **Table (5).** A wide range of variability was observed among these tested cultivars. Cultivar 'IT 81 D-994' gave the heaviest 100-dry seeds (25.69 g), while the lightest (12.65 g) were obtained from cultivar 'IT 81 D-721'.

Respecting total yield, a wide range of variability was found among the tested as shown in **Table (5).** Cultivar 'IT 93 K 12904' produced the highest value for total yield of dry seeds (1110.8 kg/fed). On the other hand cultivar 'IT 81 D-994' gave the lowest value in this character (247.3 kg/fed). Our results on weight of 100-dry seeds and total yield of seeds/fed are in agreement with those obtained by **Abdel-Salam & El-Hakeem (1970); Ojehomon (1970); Kohli *et al* (1971); Malash (1971); Abo-Baker *et al* (1983); Abdel-Ati (1983); Gamil & Gad El-Hak (1984); Davis *et al* (1986) and Gad El-Hak *et al* (1988).**

Table 5. Weight of 100-seeds (g) and seed yield (kg/fed) for 21 cultivars of cowpea evaluated during the summer planting in 2004 and 2005 seasons, Sohag, Egypt.

Code No.	Cultivars	Weight of 100- dry seeds (g)			Dry seed yield (kg/fed)		
		2004	2005	Mean	2004	2005	Mean
1	IT 85 F-2205	20.39 i	20.63 ghi	20.51 F	465.8 k	465.9 k	465.9 K
2	IT 82 D-889	16.41 o	16.50 o	16.46 J	603.7 g	600.0 gh	601.9 G
3	IT 81 D-1064	15.05 p	15.23 p	15.14 K	402.5 o	401.8 o	402.2 O
4	IT 81 D-721	12.68 s	12.62 s	12.65 N	595.6 h	594.2 h	594.9 H
5	TVU 3236	16.73 no	16.37 o	16.55 J	448.6 l	449.1 l	448.8 L
6	IT 81 D-994	25.66 a	25.72 a	25.69 A	248.0 r	246.7 r	247.3 R
7	IT 93 K 2045-20	16.92 no	16.59 o	16.76 J	665.8 f	665.9 f	665.9 F
8	IT 93 K 273-201	21.58 def	21.52 ef	21.55 E	519.1 j	519.4 j	519.2 J
9	IT 93 K 12904	18.07 lm	18.16 kl	18.12 H	1110.4 a	1111.1 a	1110.8 A
10	IT 90 K 1020-6	23.08 c	23.47 c	23.28 C	270.1 q	272.4 q	271.3 Q
11	IT 93 K 370	21.28 fg	21.19 fgh	21.24 E	341.2 p	340.6 p	340.9 P
12	IT 89K D 374-57	21.80 def	21.65 def	21.72 DE	792.4 c	793.4 c	792.9 C
13	IT 93K 624	22.03 de	22.30 d	22.16 D	716.2 d	716.2 d	716.2 D
14	IT 90 K 2840-2	20.53 hi	20.38 i	20.46 F	521.1 j	521.6 j	521.4 J
15	IT 98 K 2064-2	17.43 mn	17.37 n	17.40 I	977.9 b	978.8 b	978.4 B
16	IT 93 K 2046-1	24.94 b	24.79 b	24.87 B	426.8 n	426.5 n	426.6 N
17	Black eye	18.77 jk	19.07 j	18.92 G	439.8 m	439.8 m	439.8 M
18	TVU 21	21.30 efg	21.39 ef	21.35 E	572.1 i	572.2 i	572.2 I
19	Black Crowder	14.17 q	14.35 q	14.26 L	605.2 g	605.8 g	605.5 G
20	Creamy 7	13.49 r	13.46 r	13.47 M	448.3 l	448.9 l	448.6 L
21	Dokki 331	13.16 rs	13.31 rs	13.23 M	698.9 e	699.7 e	699.3 E
	Mean	18.36 A	18.38 A		565.2 A	565.3 A	

Means within each column followed by the same letter(s) are not significantly different at the 0.05 probability level.

III- Seed susceptibility to the cowpea weevil (*Callosobruchus maculatus*)

1- Preference and Non-preference

The oviposition choice tests measured non-preference resistance. Data revealed highly significant difference among cowpea cultivars. According to the equation described by **Semeada (1985) and Nosser (1996)**, the 21 cowpea cultivars can be divided into five groups of preference **(Table 6)**. The first one includes Creamy7, IT 81D-721, IT 93K-624, TVU21, IT 90K-10206 and Dokki 331, this group was highly preferred to *C. maculatus*. The second group was preferred includes IT 89 KD 374-57, Black Crowder, IT 85F-2205, Black eye, IT 90K-28402, IT 93K- 273-201 and TVU3236. While the third group included IT 93K-370 and IT 93K-2045-20 as slightly preferred to *C. maculatus*. However, the fourth group were IT 81 D-994, IT 93 K 2046-1, IT 98 K 2064-2 and IT 82 D-889 were the moderately preferred, while the fifth group was non-preferred and included two cultivars (IT 81D-1064 and IT 93K 12904). Our observation on the selected cowpea cultivars suggests that the highly preferred cultivars were large and smooth or mildly-rough seeded. However, the slightly preferred cultivars were large and rough, while, the moderately preferred cultivars were large and smooth or rough. On the other hand, the only non-preferred cultivars (IT 81D-1064 and IT 93K 12904) were small and smooth or rough seeded. Thus cowpea cultivars resistance to *C. maculatus* may include some sort of antixenosis.

Our finding agrees with previous studies reported by **Newanze *et al* (1975)** who found that *C. maculatus* prefers smooth-coated and well-filled seeds to rough and wrinkled ones for oviposition. **Mitchell (1975)** revealed that host preference in this species due to chemical cues, females show preference for large, smooth seeds. **Mbata (1992)** reported that the surface area of cowpea seeds varies among varieties and the number of eggs laid per seed is positively correlated with the surface area. However, in a no-choice oviposition experiment, the bruchid, Bruchidius atrolineatus females laid equally in all cowpea varieties **(Ofuya and Credland, 1995).**

Table 6. Cowpea seed surface texture, preference degree and number of eggs laid per four females of *Callosobruchus maculatus* on 25 seeds of different cowpea cultivars.

Code No.	Cultivars	Seed Surface texture	No. of eggs laid on seeds	Preference degree
1	IT 85 F-2205	Smooth	130.00 b	P
2	IT 82 D-889	Smooth	47.33 fgh	MP
3	IT 81 D-1064	Smooth	32.67 h	NP
4	IT 81 D-721	Smooth	145.00 ab	HP
5	TVU 3236	Mildly Rough	120.67 bc	P
6	IT 81 D-994	Rough	71.00 ef	MP
7	IT 93 K 2045-20	Rough	99.67 cd	SP
8	IT 93 K 273-201	Mildly Rough	122.00 bc	P
9	IT 93 K 12904	Rough	41.33 gh	NP
10	IT 90 K 1020-6	Smooth	142.33 ab	HP
11	IT 93 K 370	Rough	80.00 de	SP
12	IT 89K D 374-57	Mildly Rough	134.00 b	P
13	IT 93K 624	Smooth	145.00 ab	HP
14	IT 90 K 2840-2	Mildly Rough	125.33 b	P
15	IT 98 K 2064-2	Rough	50.00 fgh	MP
16	IT 93 K 2046-1	Rough	57.67 efg	MP
17	Black eye	Mildly Rough	126.67 b	P
18	TVU 21	Mildly Rough	143.33 ab	HP
19	Black Crowder	Smooth	132.67 b	P
20	Creamy 7	Mildly Rough	160.00 a	HP
21	Dokki 331	Mildly Rough	142.00 ab	HP

Means followed by the same letter(s) are not significantly different at 0.05 level of probability
HP = highly preferred, P = Preferred, SP = slightly preferred, MP = Moderate Preferred and NP = Non-Preferred.

2- Antibiosis

2.1. Effect of cowpea cultivars on the total number of the emerged adults

Data in **Table (7)** represent number of adult emerged from forty cowpea seeds exposed to newly emerged one male and one female of *C. maculatus* reared on the same cultivars. Obtained results showed that the largest number of emerged adults was recorded from the cowpea cultivars Creamy 7, IT 81D-721 and Dokki 331 with an average of 71.67, 63.33 and 61.0 individual / 40 cowpea seeds, respectively. However, the fewest number of emerged adults were recorded from the cowpea cultivars IT 81D-1064 and IT 93K-12904 with an average of 5.0 and 6.0 individuals / 40 cowpea seeds, respectively. Concerning the percentage of damaged seeds, statistical analysis of the data revealed that a highly significant differences among the tested cowpea cultivars. The cowpea cultivars Creamy7, IT 81D-721 and Dokki 331 had the highest damage percentage (52.5, 47.5 and 45.0%, respectively). However, the cowpea cultivars IT 81D-1064 and IT 93K-12904 had the lowest damage percentage (12.5 and 18.3%). Our finding agree with those reported by Singh *et al.* (1985) who observed that the number of emerging adults determines the extent of damage and consequently seeds permitting more rapid and higher levels of adult emergence will be more extensively damaged.

Table 7. Mean of parameters in cowpea cultivars screened for susceptibility to *Callosobruchus maculatus* under laboratory conditions.

Code No.	Cultivars	No. of adult emerged	% damaged seeds	Mean developmental period (days)	Average life span of female (days)
1	IT 85 F-2205	45.00 fg	35.83 efg	19.00 gh	7.00 ab
2	IT 82 D-889	8.00 l	22.50 j	26.00 bc	5.00 cd
3	IT 81 D-1064	5.00 m	12.50 k	31.00 a	4.67 d
4	IT 81 D-721	63.33 b	47.50 b	20.00 fgh	6.00 a-d
5	TVU 3236	44.00 g	32.50 gh	19.67 fgh	6.00 a-d
6	IT 81 D-994	10.00 k	22.50 j	19.67 fgh	6.00 a-d
7	IT 93 K 2045-20	36.00 i	37.50 ef	19.67 fgh	6.67 abc
8	IT 93 K 273-201	37.33 hi	30.00 hi	23.00 de	6.33 a-d
9	IT 93 K 12904	6.00 m	18.33 j	27.33 b	5.00 cd
10	IT 90 K 1020-6	38.00 h	35.00 fg	19.00 gh	5.00 cd
11	IT 93 K 370	20.00 j	27.50 i	19.00 gh	5.33 bcd
12	IT 89K D 374-57	44.00 g	32.33 gh	21.00 efg	7.33 a
13	IT 93K 624	49.00 e	40.00 de	18.00 h	7.00 ab
14	IT 90 K 2840-2	45.00 fg	29.83 hi	22.00 def	5.00 cd
15	IT 98 K 2064-2	8.00 l	20.00 j	21.00 efg	5.67 a-d
16	IT 93 K 2046-1	11.00 k	21.67 j	24.00 cd	6.00 a-d
17	Black eye	46.00 f	27.50 i	20.67 fg	7.00 ab
18	TVU 21	60.00 c	42.50 cd	20.33 fgh	6.67 abc
19	Black Crowder	55.00 d	37.50 ef	20.00 fgh	6.67 abc
20	Creamy 7	71.67 a	52.50 a	20.00 fgh	6.67 abc
21	Dokki 331	61.00 c	45.00 bc	18.00 h	6.33 a-d

Means followed by the same letter(s) are not significantly different at 0.05 level of probability.

2.2. Effect of cowpea cultivars on the on the biology of *C. maculatus*

Data obtained in **Table (7)** exhibit the total development time (TDT) of *C. maculatus* larvae and average life-span (longevity) of adults recovered from each cowpea cultivars. Statistical analysis of the data revealed highly significant differences among the tested cowpea cultivars in respect to the developmental period and adult life-span. The results indicated that the development of *C. maculatus* was significantly slower when reared on the cowpea cultivar IT 81D-1064, IT 93K-12904 and IT 82D-889 (with an average of 31.00, 27.33 and 26.00 days, respectively) than when reared on other cowpea cultivars. On the other hand, females reared on these cowpea cultivars lived shorter than those reared on other tested cultivars. **Redden *et al.* (1983) and Redden & McGuire (1983)** recommended that total development time (TDT) are the most important variables in cowpea resistance to *C. maculatus*.

Data in **Table (8)** showed the number of eggs laid per female (Fecundity) and the mean percentage of adults emerged by exposure 40 cowpea seeds to one male and one female reared on the 21 cultivars. Statistical analysis of the data revealed highly significant differences among the tested cowpea cultivars in respect to fecundity and percentage of emerged adults. Females reared on the cowpea cultivars Creamy7 laid more eggs with an average of 80.0 eggs / female. So, it appeared as more fecund than those reared on the other cowpea cultivars. Meanwhile, females reared on the cowpea cultivar IT 81D-1064 and IT 93K12904 were less fecund because it laid 19.00 and 21.67 eggs / female, respectively.

Table 8. Emergence of adult *Callosobruchus maculatus* from eggs laid and damage by *Callosobruchus maculatus* reared on different cowpea cultivars in the laboratory.

Code No.	Cultivars	Mean of egg laid per female	Mean % of adult emergence	% loss in seed weight	Mean weight of one emerged adult (g)
1	IT 85 F-2205	65.00 cd	69.22 b	25.33 fgh	0.096 a-d
2	IT 82 D-889	25.00 j	31.93 f	13.57 kl	0.067 cd
3	IT 81 D-1064	19.00 l	26.46 f	4.35 m	0.057 d
4	IT 81 D-721	71.33 b	88.78 a	41.00 b	0.092 a-d
5	TVU 3236	61.00 e	72.15 b	25.10 gh	0.109 a-d
6	IT 81 D-994	35.00 h	28.55 f	13.73 kl	0.095 a-d
7	IT 93 K 2045-20	50.00 f	72.03 b	30.91 e	0.104 a-d
8	IT 93 K 273-201	62.33 e	59.92 c	25.82 fg	0.110 a-d
9	IT 93 K 12904	21.67 k	28.00 f	11.33 i	0.100 a-d
10	IT 90 K 1020-6	71.00 b	53.53 d	28.20 f	0.113 a-d
11	IT 93 K 370	41.00 g	48.78 d	19.37 j	0.110 a-d
12	IT 89K D 374-57	66.00 c	62.05 c	24.11 ghi	0.152 a
13	IT 93K 624	71.00 b	68.70 b	33 78 cd	0.110 a-d
14	IT 90 K 2840-2	62.67 e	71.86 b	22.67 hi	0.099 a-d
15	IT 98 K 2064-2	26.00 j	30.75 f	25.75 fg	0.098 a-d
16	IT 93 K 2046-1	29.00 i	38.00 e	15.28 k	0.099 a-d
17	Black eye	63 00 de	73.02 b	21.58 ij	0.101 a-d
18	TVU 21	72.00 b	83.35 a	35.42 c	0.079 bcd
19	Black Crowder	66.33 c	82.94 a	31.81 de	0.131 ab
20	Creamy 7	80.33 a	89.29 a	47.00 a	0.124 abc
21	Dokki 331	71.33 b	85.55 a	34.92 c	0.140 ab

Means followed by the same letter(s) are not significantly different at 0.05 level of probability

Regarding the percentage of emerged adults, the highest percentage of emerged adult was observed for the cowpea cultivar Creamy7 with an average of 89.29%. However, the lowest percentage of adults emerged (26.46%) was recorded from the cowpea cultivar IT81D-1064 with an average number of eggs laid 19.00 / female. The above mentioned results indicated that the cowpea cultivar IT 81D-1064 exhibited the fewest number of emerged adults, the lowest percentage of emerged adults. However, longevity might not have an important role in the resistance of this cultivar. These findings may be attributed to the presence of some sort of antibiosis in the previously mentioned cultivar. In general, the varietal differences were significant for the susceptibility of *C. maculatus* in terms of the ability of this bruchid larvae to develop into adults (measured by percentage of adults emerged), seed of development and life-time fecundity of females. These effects would reduce the build-up of the pest population on the cowpea during storage, thus minimize damage caused by this pest.

Our finding is in agreement with that obtained by **Ofuya (1987b)**, who stated that the resistance of cowpea cultivars IT 81D-987 and Popse to *C. maculatus* damage seems to be due to antibiosis. This criteria was used in the present study to determine the presence of antibiosis in the tested cowpea cultivars as previously adapted by several investigators such as **Ofuya (1987a and b) and Murdock *et al* (1990)**. So, the cowpea cultivars IT 81D-1064, IT 93K 12904 and IT 82D-889 may be used by geneticists and plant breeders to develop more resistant cultivars against the cowpea seed beetle *C. maculatus*.

3- Tolerance

Data in **Table (8)** indicated mainly the quantity and percentage of loss in weight per 100 cowpea seeds caused by feeding of the progeny resulted from the artificially infestation with *C. maculatus*. Statistical analysis of the data revealed highly significant differences among cowpea cultivars in respect to the percentage of loss in weight of the tested cowpea cultivars. The cowpea cultivars Creamy7 and IT 81 D-721 recorded the highest percentage of loss in weight with an average of 47.0 and 41.0%, respectively. Meanwhile, the cowpea cultivars IT 81D-1064, IT 93K-12904 and IT 82 D-889 recorded the lowest percentage of loss in weight with an average of 4.16, 11.61 and 13.50 %, respectively. The difference in percentage of weight loss in all cowpea cultivars could be attributed to the tolerance degree of each cultivar. Therefore, the cowpea cultivars IT 81D-1064, IT 93K-12904 and IT 82D-889 could be considered as the least susceptible (tolerated) cultivars. The adults emerged from the different cowpea cultivars were differed in body weight. The highest body weight average of 0.152, 0.140 and 0.131 were obtained from those reared on the cowpea cultivars IT 89KD 374-57, Dokki 331 and Black Crowder, respectively.

However, the lowest body weight averages of 0.057, 0.067 and 0.079 were obtained from those reared on the cowpea cultivars IT 81D-1064, IT 93K-12904 and IT 82D-889, respectively. The emerged adults from these cultivars were smallest than those obtained from other cowpea cultivars. The difference in body weight may be related to the size and weight of seeds. The loss in seed weight of cowpea and four related pulse grains caused by *C. maculatus* was studied by **Nakhla (1988)**, who recorded 19.71% loss in weight of 100 seeds of Black eye cowpea as affected by artificially infestation by *C. maculatus*. **Ofuya and Credland (1995)** calculated the seed weight loss of 20 cowpea cultivars due to feeding by one larva of *Bruchidius atrolinatus* (Pic.). They reported that the beetle larvae reared on the least susceptible varieties (tolerant) were consumed less of their seed material and adults reared from them were smallest and less fecund.

Results showed highly significant differences among cowpea cultivars in choice antixenosis experiment. The cowpea cultivars Creamy7, IT 93K 624, TVU21, IT 90K1020-6 and Dokki 331 were highly preferred (HP) cultivars. However, the IT 81D-1064 and IT 93K 12904 were seemed to be non-preferred (NP) cultivars. These differences may be due to the cowpea seed size and texture. Results of **Messina and Renwick (1985)** on non-preference resistance of cowpea varieties to *C. maculatus* agree with the known preference of *C. maculatus* to large and smooth seeds. The tested cultivars differed significantly in their susceptibility to *C. maculatus* in terms of the ability of laying eggs, emergence and ability of larvae to develop to adults, seed of development, fecundity, weight loss and weight of freshly emerged adults. The cowpea cultivars 'IT81D-1064, IT93K 12904 and IT82D-889 showed some sort of antibiosis to the cowpea seed beetle, *C. maculatus*. This was manifested in the low number of the laid eggs, the fewest number of emerged adults, the longer period of larval development and small quantity of con-

sumed food. Other factors including high protein content and levels of trypsin inhibitor that cause antibiosis to larvae have been correlated to resistance of other cowpea varieties to *C. maculatus* **(Messina & Renwick, 1985; Fitzner *et al* 1985; Singh *et al* 1985; Ofuya, 1987a and b and Kitch *et al* 1991).**

From this study it could be concluded that some introduced cultivars of cowpea tested under our Upper Egypt conditions, have high total dry-seed yield and high tolerance to weevil insect injury, especially cultivar IT 93K-12904. These cultivars may be useful for cultivation in Egypt and may help to overcome crop damage caused by cowpea weevil injury.

REFERENCES

Abdel-Ati, Y.Y. (1983). Evaluation of Some Cowpea Varieties. pp 25- 70 . M.Sc. Thesis, Faculty of Agriculture, Minia University, Egypt.

Abd El-Hady, M.A. (1998). Inheritance Studies of Some Economic Characters in Cowpea (*Vigna unguiculata* L. Walp). pp 19. M.Sc. Thesis, Faculty of Agriculture, Assiut University, Egypt.

Abdel-Salam, A.A. and M.S. El-Hakeem (1970). Performance of some American cultivars of cowpea in the U.A.R. **Bull. Inst. Desert, Vol. XX (2): 501-511.**

Abo-Baker, M.A.; S.H. Gad El-Hak and Y.Y. Abdel-Ati (1983). Comparitive studies of some cultivars of cowpea (*Vigna unguiculata* (L.) Walp). **Minia J. Agric. Res. & Dev. 5 (1): 85-89.**

Aggarwal, V.D. (1987) Selecting cowpea varieties for harsh semiarid Shalian areas, IITA Research Briefs, **International Institute of Tropical Agriculture. 8 (2): 2-20.**

Aghora, T.S.; N. Mohan and R.G. Somkuwar (1994). Evaluation of vegetable cowpea (*Vigna unguiculata* (L.) Walp) for earliness, protein content and green pod yield. **Legume Research 17 (2): 138-140. India. (C.F. Plant Breeding. Abst., 65, 12899).**

Akinola, J.O. and J.H. Davies (1978). Effects of sowing date on forage and seed production of 14 varieties of cowpea [*Vigna unguiculata* (L.) Walp]. **Experimental Agriculture 14: 197-203.**

Akundabweni, L.S., C. Peter-Paul, and B.B. Singh (1989). Evaluation of elite lines of cowpea (*Vigna unguiculata* (L.) Walp) for leaf/fodder plus grain (i.e. dual purpose). **Tropical Agriculture (Trinidad) 67: 133-136.**

Alene, A.D. and V.M. Manyong (2006). Farmer-to-farmer technology diffusion and yield variation among adopters: the case of improved cowpea in northern Nigeria. **Agricultural Economics 35: 203–211.**

Apte, M.B.; S.A. Chavan and B.B. Jadhar (1987). Genetic variability and heritability in cowpea. **Indian J. Agric. Sci. 57 (8): 596-598.**

Babaleye, T. (1988). New cowpea varieties improve food outlook. **Agribusiness Worldwide, 10 (4): 24-26. (C.F. Plant Breed. Abst. 58 (9): 8046).**

Blade, S.F.; Mather, D.E.; Singh, B.B. and D.L. Smith (1992). Evaluation of yield stability of cowpea under sole and intercrop management in Nigeria. **Euphytica 61: 193-201.**

Bliss, F.A.; L.N. Baker; I.D. Franckowiak and T.C. Hall (1973). Genetic and environomental variation of seed yield, yield components, and seed protein quantity and quality of cowpea (*Vigna unguiculata* (L.) Walp). **Crop Sci. 13: 656-660.**

Bobytatha, A.K.; R.G. Pinhero; K.R. Lyla and A.I. Thomas (1984). Comparative performance of cowpea varieties in rice fallows. **Agric. Res. J. Kerala, 22 (2): 139-142. (C.F. Plant Breed. Abst. 40 (6): 3775).**

Booker, R.H. (1967). Observations on three bruchids associated with cowpea in Nigeria. **J. Stored Products Res. 3: 1-5.**

Caswell, G.H. (1981). Damage to stored cowpea in the northern part of Nigeria. **Samaru Journal of Agricultural Research. 1: 11-19.**

Chandrappa, H.M.; A. Manjunath; S.R. Vishwanatha and G. Shivashankar (1974). Promising introductions in cowpea and their genetic variability. **Curr. Res. (Bangalore, India) 3: 123-125.**

Chaturvedi, G.S.; P.K. Aggarwal and S.K. Siwha (1980). Growth and yield of determinate and indeterminate cowpea in dry land agriculture. **J. Agric. Sci. 94 (1): 137-144.**

Damarany, A.M. (1994). Testing and screening of some cowpea (*Vigna unguiculata* (L.) Walp) genotypes under Assuit conditions. **Assiut J. Agric. Sci. 25 (4): 9-19.**

Davis, D.W.; D.B. Marsh and M.N. Alvarez (1986). MN13 and MN 150 cowpea breeding lines. **HortScience 21 (4): 1080-1081.**

Egwuatu, R.I. (1987). Current status of conventional insecticides in the management of stored product pests in the tropics. **Insect Science and its Application. 8: 695-701.**

Erksin, W. and T.N. Khan (1976). Evaluation of cowpea germplasm for grain yield potential in Papus New Guinea. **Sabrao J. 7 (2): 189-196.**

Faculty Agric. Univ. Papua New Guinea. **(C.F. Plant. Breed. Abst. 46 (10): 9724).**

Farish, L.R. (1947). Mississippi strains of cowpea show as outstanding in tests by delta station. **Mississippi Fm. Res. 10 (3): 1-8.**

Fernandez, G.C.J. and J.C. Miller (1985). Yield components analysis in five cowpea cultivars. **J. Amer. Soc. Hort. Sci. 1094: 553-559.**

Fitzner, M.S.; D.W. Hagstrum; D.A. Knauft; K.L. Buhr and J.R. McLaughlin (1985). Genotypic diversity in the suitability of cowpea (Rosales: Leguminosae) pods and seeds for cowpea weevil (Coleoptera: Bruchidae) oviposition and development. **J. Econ. Entomol., 78: 806-810.**

Gad El-Hak, S.H.; S.H. Mahmoud and R.A. Ragab (1988). An evaluation study of twenty fours genotypes of cowpea [*Vigna unguiculata* (L.) Walp]. **Minia J. Agric. Res. & Dev. 10 (1): 257-268.**

Gamil, K.H. and S.H. Gad El-Hak (1984). Genotypic evaluation for quantitative traits in cowpea (*Vigna unguiculata*). **Bull. Fac. Of Agric., Univ. of Cairo, 35 (3): 1471-1482.**

Gomez, K.A. and A.A. Gomez (1984). Statistical Procedures for Agricultural Research. John Wiley and Sons. New York.

Jackai, L.E.N. and R.A. Daoust (1986). Insect pest of cowpeas. **Annual Review of Entomology. 31: 95-119.**

Kahn, B.A. and J.P. Stofelia (1985). Yield components of cowpeas grown in two environments. **Crop Sci. 2591: 179-182.**

Kitch, L.W.; R.E. Shade and L.L. Murdock (1991). Resistance to the cowpea weevil (*Callosobruchus macullatus*) larvae in pods of cowpea (*Vigna unguiculata*). **Entomol. Exp. Applic., 60: 183-192.**

Kohli, K.S.; C.B. Singh; A. Singh; K.L. Mehra and M.L. Mgoon (1971). Variability of quantitative characters in a world collection of cowpea, interregional comparisons . **Genetics Agraria 25 (3/4): 231-242. (C.F. Field Crop Abst. Jan., 1973, 307).**

Kormawa, P.M.; C.I. Ezedinma and B.B. Singh (2004). Factors influencing farmer-to-farmertransfer of an improved cowpea variety in Kano State, Nigeria. **Journal of Agriculture and Rural Development in the Tropics and Subtropics 105: 1– 13.**

Kristjanson, P.; I. Okike; S. Tarawali; B.B. Singh and V.M. Manyong (2005). Farmers' perceptions of benefits and factors affecting the adoption of improved dual–purpose cowpea in the dry savannas of Nigeria. **Agricultural Economics 32:195–210.**

Malash, N.M.A. (1971). Evaluation of New Varieties of Cowpea in the New Valley. pp 50- 90. M.Sc. Thesis, Faculty of Agriculture, Cairo University, Egypt.

Mbata, G.N. (1992). Egg distribution on seed by valuation of susceptibility of varietes of cowpea to *Callosobruchus subinnotatus* (Pic.) (Coleoptera-Bruchidae). **Stored Products Research. 28: 301-303.**

Mbata, G.N. (1993). Evaluation of susceptibility of varietes of cowpea to *Callosobruchus maculatus* (F.) and *Callosobruchus subinnotatus* (Pic) (Coleoptera- Bruchidae). **Stored Products Research. 29: 207-213.**

Messina, F.I. and I.A.A. Renwick (1985). Resistance to *Callosobruchus maculatus* (Coleoptera: Bruchidae) in selected cowpea lines. **Environ. Entomol. 14: 868-872.**

Mitchell, R. (1975). The evolution of oviposition tactics in been weevil, *Callosobruchus maculatus* (F). **Ecology. 56: 696-702.**

Murdock, L.L.; J.E. Huesing; S.S. Nielsen; R.C Pratt and R.E. Shade (1990). Biological effects of plant lectins on the cowpea weevil. **Phytochemistry. 29: 85-89.**

Nakhla, I.M. (1988). Loss in seed weight of five different pluse grain caused by the cowpea weevil *Callosobruchus macullatus* (F.). **Agric. Res. Rev., 66: 71-75.**

Nassr, S.A. (1981). A Comparative Study of Six Cowpea Varieties with Reference to Seed Production. pp 30-70. M.Sc. Thesis, Faculty of Agriculture, Minia University, Egypt.

Newanze, K.F.; E. Horber and C.W. Pitts (1975). Evidence for ovipositional preference of Callosobruchus macullatus for cowpea varieties. Environmental Entomology. 4: 409-412.

Nosser, M.A. (1996). Mechanism of Resistance in Been and Cowpea Varieties to Certain Sucking Insect Infestation. pp 45-100. M.Sc. Thesis, Faculty of Agriculture, Cairo University, Egypt.

N'tare, B.R. (1989). Evaluation of cowpea cultivars for intercropping with pearl millet in the Sahelian Zone of West Africa. **Field Crops Research 20: 31-40.**

Ofuya, T.I. (1987). *Callosobruchus macullatus* (F.) (Coleoptera Bruchidae) oviposition behaviour on cowpea seeds. **Insect Sci. and its Application. 8: 77-79.**

Ofuya, T.I. (1987a). Susceptibility of some cowpeas to infestation and damage by the storage beetle, *Callosobruchus macullatus* (Fabricius) (Col-

eoptera: Bruchidae). **J. Agric. Sci. Canb., 108: 137-139.**

Ofuya, T.I. (1987b). Susceptibility of some Vigna species to infestation and damage by *Callosobruchus maculatus* (Fabricius) (Coleoptera: Bruchidae). **J. Stored. Prod. Res., 23: 137-138.**

Ofuya, T.I. and P.F. Credland (1995). Response of three populations of the seed beetle, *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae), to seed resistance in selected varieties of cowpea *Vigna unguiculata* (L.) Walp. **J. Stored. Prod. Res., 31: 17-27.**

Ojehomon, O.O. (1979). A comparison of the vegetative growth, development and seed yield of three varieties of cowpea, *Vigna unguiculata* (L.) Walp. **J. Agric. Sci., 74: 363-374.**

Paul, C.P.; B.B. Singh and C.A. Fatokun (1988). Performance of dual-purpose cowpea varieties. **Tropical Grain Legume Bulletin 35: 28-31.**

Prevelt, P.F. (1961). Field infestation of cowpea (*Vigna unguiculata*) pods by beetles of the families' Bruchidae and Curculionidae in northern Nigeria. **Bull. of Entomological Res. 52: 635-646.**

Redden, R.J. and J. McGuire (1983). The genetic evaluation of bruchid resistance in seed of cowpea. **Aust. J. Agric. Res. 34: 707-715.**

Redden, R.J.; P. Dobie and A.M.R. Gatehouse (1983). The inheritance of seed resistance to *Callosobruchus maculatus* F. in cowpea (*Vigna unguiculata* L. Walp) I- Analysis of parental F1, F2, F3 and backcross seed generations. **Aust. J. Agric. Res., 34: 681-695.**

Remison, S.U. (1978). The performance of cowpea [*Vigna unguiculata* (L.) Walp] as influenced by weed competition. **J. Agric. Sci. Camb. 90: 523-530.**

Semeada, A.M. (1985). Relative Susceptibility of Certain Maize Germplasm to Infestation with the Greater Sugar Cane Borer *Sesamia cretica* (led.) (Lepidoptera: Noetuidae). pp 28-65. MSc Thesis, Faculty of Agriculture, Cairo University, Egypt.

Singh, B.B. (1993) Cowpea Breeding: Archival Report (1988-1992) of Grain Legume Improvement Program. **International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, pp. 10-53.**

Singh, B.B. and B.R. N'tare (1985). Development of improved cowpea varieties in Africa. In: Singh, S.R. and K.O Rachie (eds), **Cowpea Research, Production and Utilization. pp. 105-115.** John Wiley & Sons, Chichester, UK.

Singh, S.R. and H.F. Van Emden (1979). Insect pests of grain legumes. **Annual Review of Entomology. 24: 255-278.**

Singh, Y.R.; H.P. Saxena and K.M. Singh (1985). Exploration of resistance of pulse beetle I Ovipositional preference of *Callosobruchus chinensis* Linnaeus and *Callosobruchus maculatus* Fabricius. **Indian J. Entomol., 42: 375-382.**

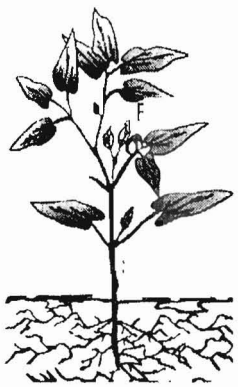
Stino, K.R.; M.A. Abdel-Fattah; A.S. Abdel-Salam and N.M. Malash (1971). Fruiting characteristics of some cowpea varieties grown under the New Valley conditions (II· Dry matter pods). **The Dessert Inst. Bull. 21 (2): 473-486.**

Summerfild, R.J.; F.R. Minchin and E.H. Roberts (1978). Realization of yield potential in soybean [*Glzcine max* (L.) Merr.] and cowpea [*Vigna unguiculata* (L.) Walp]. In CPC (British Crop Protection Council). Opportunities for Chemical Plant Growth Regulation, London, UK. **BCPC, Monograph 21: 125-134.**

Turk, K.J.; A.E. Hall and C.W. Asbell (1980). Drought adaptation of cowpeas. I. Influence of drought on seed yield. **Agron. J. 75: 413-420.**

Van Emden, H.F. (1987). Cultural methods: the plant . In Burn, A.J ; T.H. Coaker and P.C. Iepson (Ed.). **Integrated Pest Management. 27-67,** Academic Press, London.

211
حوليات العلوم الزراعية
جامعة عين شمس، القاهرة
مجلد(٥٢)، عدد (١)، ١٩٧-٢١٢، ٢٠٠٧



انتقاء بعض أصناف اللوبيا المستقدمة والمحلية للمحصول البذرى الجاف والمقاومة للاصابة بحشرة خنفساء اللوبيا (*Callosobruchus maculatus*)

[١٦]

حازم عبد الرحمن عبيد الله علي[١]- أحمد محمود على سالمان[٢]- محمود أحمد حلمى عبدالهادى[٣]

١. قسم البساتين- كلية الزراعة- جامعة سوهاج- مصر

٢. قسم وقايه النبات- كلية الزراعة- جامعة سوهاج- مصر

٣. معهد بحوث البساتين- مركز البحوث الزراعية- الجيزة- مصر

أجريت هذه التجربة لتقييم وإختبار واحد وعشرون صنفا محلياً ومستوردا من اللوبيا بالنسبة للمحصول وبعض الصفات البستانية الأخرى فى المزرعة البحثية لكلية الزراعة – جامعة سوهاج. كما تم تقييم هذه ألأصناف من حيث درجة تحملها للتخزين ومن ثم درجة تحملها للإصابة بحشرة خنفساء اللوبيا تحت الظروف المعملية بكليه الزراعة – جامعة سوهاج. بهدف دراسة إمكانية إيجاد صنف عالى المحصول ومقاوم لحشرة خنفساء اللوبيا ومقبول للمزارع والمستهلك المصرى.

ويمكن تلخيص أهم النتائج فيما يلي:

- أظهرت النتائج أن هناك تبايناً كبيراً بين هذه ألأصناف فى معظم الصفات المحصولية المدروسة.
- كان الصنف Dokki 331 أبكر الأصناف بينما كان الصنف IT 81 D-994 أكثر الأصناف تأخرا فى النضج.
- كان الصنف Blackeye الأطول ساقا بينما كان الصنف Dokki 331 أقصر الأصناف تحت الدراسة.
- أعطى الصنف IT 93K 624 اعلى القيم فى صفة طول القرن بينما اعطى الصنف IT 81 D-721 اقل القيم فى هذه الصفة.
- أعطى الصنف TVU 21 اعلى القيم فى صفة عدد الفروع على النبات بينما اعطى الصنف IT 90 K 1020-6 اقل القيم فى هذه الصفة.
- أعطى الصنف IT 81 D-1064 اعلى القيم فى صفة عدد البذور فى القرن بينما اعطى الصنف Blackeye أقل القيم فى هذه الصفة.
- أعطى الصنف IT 93 K 2045-20 أعلى القيم فى صفة إمتلاء البذور فى القرن بينما اعطى الصنف IT 93 K 2046-1 اقل القيم فى هذه الصفة.
- أعطى الصنف IT 81 D-994 أعلى القيم فى صفة وزن ١٠٠ بذرة جافة بينما اعطى الصنف IT 81 D-721 اقل القيم فى هذه الصفة.

تحكيم: ا.د إبراهيم إبراهيم العكش
ا.د محمد فؤاد

- أعطى الصنف IT 93 K 12904 اعلى القيم فى صفة المحصول البذرى الكلى الجاف بينما اعطى الصنف IT 81 D-994 اقل القيم فى هذه الصفة.

كما اظهرت الدراسة المعملية ان خنفساء اللوبيا أصابت جميع بذور تلك الأصناف بدرجات مختلفة إنعكس ذلك على عدد البيض الذى تضعه انثى الحشرة ونسبة الضرر الذى تحدثة او نسبة الحشرات التى تخرج من كل صنف هذا بالإضافة للإختلافات التى وصحت فى طول فترة النمو ووزن الحشرات الخارجة ومقدار الفقد فى وزن البذرة الذى تسببة يرقة واحدة عند تربيتها على بذور هذه الأصناف لمدة جيل واحد.

وبناء على هذه القياسات فقد اظهرت الأصناف IT 81D-1064, IT 93K-12904 and IT 82D-889 الآتى

- جانبا من عدم التفضيل لهذه الآفة لوضع البيض والتضاد الحيوى ودرجة التحمل لهذه الآفة.
- إنخفاض معنوى فى تعداد البيض الذى يوضع على بذورها.
- إنخفاض فى نسبة البذور المصابة والحشرات الخارجة منها .
- تأخر فى فترة نمو يرقات الآفة عند تربيتها على هذه الأصناف .
- كما كان إستهلاك البذور اقل فى هذه الأصناف عن ألأصناف الباقية.
- كما كانت الحشرات المرباة على بذور هذه ألأصناف اقل فى الحجم عند مقارناتها بالحشرات المرباة على ألأصناف ألأخرى.

لذا تعتبر هذه الأصناف أقل الأصناف المختبره حساسية لهذه الآفة ومن ثم يمكن التوصية بإستخدامها فى برامج التربية لأستنباط اصناف لوبيا متحملة او مقاومة لحشرة خنفساء اللوبيا كما يمكن إدخالها فى برامج المكافحة المتكاملة لهذه الآفة.

أيضا نستخلص من هذه الدراسة إمكانية زراعة الصنف IT 93K-12904 لتفوقة فى صفة المحصول البذرى الجاف للفدان وتحملة بدرجة كبيرة للإصابة بحشرة خنفساء اللوبيا عند تخزينة فضلا عن لونة المقبول للمستهلك .