Journal of Entomology and Zoology Studies 2018; 6(3): 232-235

Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(3): 232-235

Received: 04-03-2018
Accepted: 05-04-2018

Zahid Iqbal
PARC, Institute of Advanced Studies in Agriculture, The University of Agriculture Peshawar, Pakistan

Awais Rasool
Insect Pest Management Program, Institute of Plant and Environmental Protection, National Agricultural Research Centre, Islamabad, Pakistan

Javed Khan
Insect Pest Management Program, Institute of Plant and Environmental Protection, National Agricultural Research Centre, Islamabad, Pakistan

Ammara Blouch
Honey Bee Research Institute, National Agricultural Research Centre, Islamabad, Pakistan

Habib Iqbal Javed
Insect Pest Management Program, Institute of Plant and Environmental Protection, National Agricultural Research Centre, Islamabad, Pakistan

Tariq Mehmood
Insect Pest Management Program, Institute of Plant and Environmental Protection, National Agricultural Research Centre, Islamabad, Pakistan

Irfan Ahmad
Vertebrate Pest Management Program, National Agricultural Research Centre, Islamabad, Pakistan

Correspondence
Javed Khan
Insect Pest Management Program, Institute of Plant and Environmental Protection, National Agricultural Research Centre, Islamabad, Pakistan

Response of mash (*Vigna mungo*) genotypes against *Callosobruchus maculatus* F. during storage

Zahid Iqbal, Awais Rasool, Javed Khan, Ammara Blouch, Habib Iqbal Javed, Tariq Mehmood and Irfan Ahmad

Abstract
A research was conducted on the response of eight mash (*Vigna mungo*) genotypes NCH-9-9, NCH-3-4, NARC-MASH-3, CHAKWAL-MASH-97, NCH-7-5, MASH UROOJ, NARC-MASH-1 and NCH-10-1 to pulse beetle, *Callosobruchus maculates* under laboratory conditions. Two sets of experiments, No-Choice and Free-Choice tests were carried out and the results were evaluated on the basis of fecundity, development period, adult emergence, adult weight, damage and weight loss in grains. In No-Choice test, NARC-Mash-1, NCH-3-4 and Mash-Urooj showed good results with minimum grain damage 17.82± 0.56%, 18.27±0.66% and 18.43± 0.55%, respectively. While maximum damage (23.86± 0.52%) was shown by NCH-7-5. In Free-Choice test, NCH-10-1 performed best with 12.29± 0.45% grain damage followed by NARC-Mash-3 (13.70± 0.47%), NCH-3-4 (14.06± 0.20%) and Mash-Urooj (17.33± 0.59%). While NARC-Mash-1 showed maximum grain damage (23.45± 0.49%) contemporary to its result in NO-Choice test. One genotype NCH-9-9 showed almost similar results 22.74± 1.15% and 22.88± 0.57% in both No-Choice and Free-Choice tests. NCH-3-4 and Mash-Urooj performed well under both types of tests. Damage was positively correlated with the number of eggs, weight loss and adult emergence but negatively correlated with developmental period and 100 grain weight.

Keywords: Pulse beetle (*Callosobruchus maculatus*), Mash (*vigna mungo*) genotypes, No-Choice tests, Free-Choice tests

1. Introduction

Pulses play a vital role in the daily food of majority of the people living in developing countries because these have 20-30% protein, which is three times more than in cereals [1]. In Pakistan, commonly grown pulses are chickpea, lentil, mung, mash and khesari [2]. These are usually grown on marginal lands in Pakistan. Stored grain insect pests damage the pulse seeds greatly in stores [3]. They cause grain damage, weight loss and thus reduce the market and nutritional value as it becomes unfit for human consumption. The adult beetles do not eat seeds but they use them a surface for mating and oviposition. The newly hatched beetle larva bores into the seeds and feeds on its contents till the whole endosperm is eaten up [4]. In case of intensive influx, the grain loss reduces their germination potential thus affecting crop yield. The beetles of the genus *Callosobruchus* are economically important pests for pulse grains [5-7]. It is estimated that 55-60% loss in grain weight and 45.50 to 66.30% loss in protein content of pulses is due to invasion caused by this beetle [8] and it may be up to 100% [9].

Pulse beetle *C. maculates* is a universal pest, which infests pods in the fields and grains in the stores. Its influx rate is lower at harvest and untraceable. The pest reproduces to new generations every month. It is required to reduce these losses by controlling them efficiently [10]. Insecticides are the most effective and quick methods of insect control [11] but have several adverse effects like environmental pollution and biohazard to human beings. The insecticides also cause residual problems in the products. Due to regular spray, insect pests may develop resistance against certain insecticides [12]. For this purpose, the genotypes with resistance in grains against insect pests can be stored, whose storage can be the economical and free from any environmental hazards. The present research was carried out with a vision to find out the appropriateness of various genotypes of mash in the expansion of this pest and level of damage by studying its biological parameters.

2. Materials and Methods

The experiments were conducted in the laboratory of Insect Pest Management Program, Institute of Plant and Environmental Protection, National Agricultural Research Center Islamabad under controlled conditions during the year 2014. All the experiments were conducted under controlled conditions in growth chamber at 28±2ºC and 65± 5% relative humidity. Genotypes used for screening were NCH-9-9, NCH-3-4, NARC-MASH-3, CHAKWAL-MASH-97, NCH-7-5, MASH-UROOJ, NARC-MASH-1, NCH-10-1. The grains of all genotypes were damage free. The culture of *C. maculates* was maintained on chickpea at 28±2Cº and 60±5% R.H. with 12:12 hr light: dark cycle for a number of generations in the laboratory to make it homogenous. Morpho-chemical analysis of candidate genotypes was performed to know the chemical composition and physical structure. Two tests, No-Choice and Free-Choice were applied.

2.1 No-Choice Test

In the No-Choice test, 20 gram of each of eight mash genotypes was placed in separate glass jars (10×5cm). The trial was conducted with 8 treatments (8 genotypes) under Completely Randomized Design with three replications. In this test, adults were confined to oviposit and develop on all genotypes separately. Five pairs of newly emerged adults from homogenous culture were released in glass jars containing 20 gram of mash genotypes. Jars were covered with muslin cloth. The rim of lid was held tightly on the jar so as to avoid the escape of pulse beetle and provide sufficient air. Female adults laid eggs on the grains. The eggs were counted after 15 days, insects were removed and the grains were again kept in respective jars under the same conditions. On hatching, insects were allowed to remain there until adult emergence.

2.2 Free-Choice Test

In Free-Choice test, all the genotypes were subjected to the attack of pulse beetle freely on all genotypes as described by Raina (1971) and Dahms (1972). In this way**,** complete choice was given to pulse beetle to oviposit on any of mash genotypes. For this purpose, Free-Choice testing Apparatus measuring 36 x 24 x 6.8 cm^3 having 30 equal sections of 2.5 cm^3each was used. Five gram of each of mash genotypes was placed in small sections randomly arranged in Completely Randomized Design with three replications. Thirty pairs of newly emerged adults of *C. maculatus* were released in each main chamber which was covered with muslin cloth. Female adults laid eggs on the grains. The eggs were counted after 15 days, insects were removed and the grains were again kept in respective jars under the same conditions. On hatching, insects started feeding on grains. The insects were allowed to remain there until adult emergence.

The percent weight loss and percent damaged grains were calculated by following formula as described by [15].

$$\text{Damaged Grains (\%)} = \frac{\text{Damaged grain}}{\text{Total grains}} \times 100$$

$$\text{Weight loss\%} = \frac{\text{Initial grains weight} - \text{Final grains weight}}{\text{Initial grains Weight}} \times 100$$

$$\text{Adult emergence (\%)} = \frac{\text{Adult Emerged}}{\text{Total numbers of eggs laid}} \times 100$$

The data recorded in both experiments was subjected to statistical analysis by using statistics 8.1 for one way analysis of variance and the means were compared by using LSD test.

3. Results and Discussion

The results of both tests No-Choice and Free-Choice were interpreted and the genotypes were evaluated on the basis of damage and weight loss in grains due to the feeding of *C. maculates* as well as its fecundity, development period, adult emergence and adult weight on each genotype. Different genotypes showed response to *C. maculates* differently under No-Choice and Free-Choice techniques.

3.1 No-Choice Test

The results showed that in No-Choice test, NARC-Mash-1, NCH-3-4 and Mash-Urooj showed good results with minimum grain damage as 17.82± 0.56%, 18.27±0.66% and 18.43± 0.55%, respectively. While maximum damage (23.86± 0.52%) was shown by NCH-7-5. Wight loss was minimum in Mash-Urooj with a mean value of 20.41± 0.60% followed by NCH-9-9 (22.81± 0.60%), NARC-Mash-1 (23.79± 0.58%) and NCH-3-4 (24.9± 0.60%). Maximum weight loss (31.79± 0.50%) occurred in Chakwal-Mash-97 followed by NCH-7-5 (31.70± 0.62%). *C. maculates* showed maximum fecundity (174.77± 0.58%) on NCH-7-5, It might be because of its bold size (Table 3). while maximum no. of adults emerged (72.02± 0.57%) in NARC-Mash-3 as development period was also minimum (29.77± 0.55) on it. (Table 1).

Table 1: Response of Mash (*Vigna mungo*) genotypes against *Callosobruchus maculatus* in No-Choice Test

Genotypes	Damaged Grains Mean± SD (%)	Weight Loss Mean± SD (%)	Total Eggs Mean± SD (No.)	Adult Emerged Mean± SD (%)	Per Adult Weight Mean± SD (mg)	Development Period Mean± SD (days)
NCH-9-9	22.74 ± 1.15 ab	22.81 ± 0.60 d	142 ± 0.57 e	65.68 ± 0.57 b	1.97 ± 0.07 a	30.77 ± 0.56 a
NCH-3-4	18.27 ± 0.66 c	24.9 ± 0.60 c	131.77 ±0.54 g	61.87 ± 0.60 c	1.17 ± 0.02 b	31.00 ± 0.57 a
NARC-Mash-3	21.23 ± 0.66 b	31.48 ± 0.57 a	122.33 ±0.49 h	72.02 ± 0.57 a	1.11 ± 0.04 b	29.77 ± 0.55 a
Chakwal-Mash-97	21.34 ± 0.62 b	31.79 ± 0.50 a	155.77 ± 0.52 c	59.76 ± 0.58 d	1.89 ± 0.06 a	30.00 ± 0.57 a
NCH-7-5	23.86 ± 0.52 a	31.70 ± 0.62 a	174.77 ± 0.58 a	55.15 ± 0.57 f	1.19 ± 0.04 b	30.33 ± 0.41 a
Mash-Urooj	18.43 ± 0.55 c	20.41 ± 0.60 e	147.66 ± 0.52 d	50.04 ± 0.58 h	1.16 ± 0.02 b	31.33 ± 0.51 a
NARC-Mash-1	17.82 ± 0.56 c	23.79 ± 0.58 cd	137.00 ± 0.57 f	56.99 ± 0.33 e	1.12 ± 0.04 b	30.00 ± 0.57 a
NCH-10-1	21.84 ± 0.59 ab	27.7 ± 0.49 b	171.00 ± 0.57 b	53.21 ± 0.59 g	1.83 ± 0.03 a	29.77 ± 0.56 a
LSD (*P*<0.05)	2.087	1.726	1.654	1.674	0.143	1.637

Means with different lower case letters column wise are significantly different from each other at *P value* ≤ 0.05 (One-way ANOVA), using LSD test

3.2 Free Choice Test

In Free-Choice test, NCH-10-1 performed best with least grain damage (12.29± 0.45%) followed by NARC-Mash-3 (13.70± 0.47%), NCH-3-4 (14.06± 0.20%) and Mash-Urooj (17.33± 0.59%). While, NARC-Mash-1 showed maximum grain damage (23.45± 0.49%). One genotype NCH-9-9 showed almost similar results 22.74± 1.15% and 22.88± 0.57% in both No-Choice and Free-Choice tests. While NARC-Mash-1 showed totally opposite results in both tests in terms of grain damage caused by *C. maculates*. In Free-Choice test it showed maximum damage, while in No-Choice test it showed minimum damage. NCH-3-4 and Mash-Urooj performed well under both types of tests (Table 2). Overall, maximum damage and weight losses in grains due to *C. maculates* were 23.86 and 31.79% under No-Choice test (Table 1) and 23.45 and 19.53% under Free-Choice test (Table 2).

Table 2: Response of Mash (*Vigna mungo*) genotypes against *Callosobruchus maculatus* in Free-Choice

Genotypes	Damaged Grains Mean± SD (%)	Weight Loss Mean± SD (%)	Total Eggs Mean± SD (No.)	Adult Emerged Mean± SD (%)	Per Adult Weight Mean± SD (mg)	Development Period Mean± SD (days)
NCH-9-9	22.88 ± 0.57 a	19.53 ± 0.26 b	30.77 ± 0.56 a	77.27 ± 0.52 d	1.14 ± 0.01 d	31.00 ± 0.57 a
NCH-3-4	14.06 ± 0.20 d	6.77 ± 0.16 g	24.00 ±0.57 de	68.15 ± 0.35 f	1.62 ± 0.07 b	31.00 ± 0.57 a
NARC-Mash-3	13.70 ± 0.47 de	31.48 ± 0.47 a	20.00 ±0.57 f	66.46 ± 23.71 g	1.45 ± 0.05 c	29.00 ± 0.57 b
Chakwal-Mash-97	19.72 ± 0.53 b	13.13 ± 0.56 e	28.00 ± 0.57 b	73.17 ± 9.71 e	1.62 ± 0.07 b	30.00 ± 0.57 ab
NCH-7-5	20.30 ± 0.55 b	14.83 ± 0.54 cd	25.00 ± 0.57 cd	86.03 ± 4.19 c	1.12 ± 0.01 d	29.00 ± 0.57 b
Mash-Urooj	17.33 ± 0.59 c	13.70 ± 0.54 de	22.33 ± 0.47 e	72.11 ± 14.38 e	1.45 ± 0.07 c	29.00 ± 0.57 b
NARC-Mash-1	23.45 ± 0.49 a	15.33 ± 0.58 c	25.77 ± 0.56 c	95.58 ± 4.10 a	1.92 ± 0.03 a	30.00 ± 0.57 ab
NCH-10-1	12.29 ± 0.45 e	8.77 ± 0.30 f	15.00 ± 0.57 g	87.99 ± 11.91 b	1.31 ± 0.04 c	29.00 ± 0.57 b
LSD (P<0.05)	1.497	1.372	1.688	1.468	0.161	1.730

The parameters of chemical composition have non-significant correlation with damage, adult emergence, developmental period and 100 grain weight (Table 4). Physio-chemical analysis is in close conformity with the interpretations of Khattak *et al*., (1996).

Table 3: Physical Features of Mash grains

Genotypes	Size	Texture	Surface	100 seed Weight (gm)
NCH-9-9	Medium	Rough	Dull	4.71
NCH-3-4	Medium	Rough	Dull	4.45
NARC-Mash-3	Bold	Rough	Dull	4.72
Chakwal-Mash-97	Bold	Smooth	Dull	4.41
NCH-7-5	Bold	Rough	Dull	4.48
Mash-Urooj	Medium	Rough	Dull	4.81
NARC-MASH-1	Bold	Rough	Dull	4.64
NCH-10-1	Bold	Smooth	Dull	4.50

Table 4: Chemical Composition of Mash grains

Genotypes	Protein (%)	Moisture (%)	Ash (%)	Fat (%)	Fiber (%)	Carbohydrate (%)
NCH-9-9	25.40	8.34	3.19	1.04	3.21	58.82
NCH-3-4	26.38	8.08	3.31	1.11	3.10	58.02
NARC-Mash-3	25.28	8.56	2.88	1.12	3.05	59.11
Chakwal-Mash-97	26.18	8.18	3.22	1.04	3.25	58.13
NCH-7-5	25.60	8.45	3.15	1.09	3.96	57.75
Mash-Urooj	25.81	8.37	3.07	1.05	3.94	57.76
NARC-Mash-1	25.20	8.29	3.15	1.08	3.00	59.28
NCH-10-1	25.34	8.41	3.24	1.19	3.03	58.79

Damage was found to be positively correlated with number of eggs, weight loss and adult emergence but negatively correlated with developmental period and 100 grain weight (Table 5). Regardless of type of tests weight losses of 30-40% to different pulses were noted as studied by Srinivasan and Durairaj (2007). According to Shaheen *et al*., (2006) susceptible varieties had higher damage, weight losses, adult emergence and adult weight. In contrast, Singh and Sharma (1981) recorded more weight losses in shining mung grains. Siddiqa *et al*., (2013) also evaluated that that none of the cultivar of chick pea (*Cicer arietinum* L.) showed completely resistance to *C. chinensis*, however, their response in both no-choice and free choice test varied significantly.

Table 5: Correlations of Damage with Eggs, Weight loss, Adult emergence, Development period and 100 grain weight on Mash grains

	Eggs	Weight loss	Adult emerged	Development period	100 grain weight
Damage	0.563	0.589	0.223	-0.371	-0.293
Probability	0.139	0.117	0.592	0.360	0.478

4. Conclusion

Grains with maximum *C. maculates* eggs showed more damage and more weight loss due to feeding of the insect. With more feeding on grains, developmental period of *C. maculates* was short with increased adult emergence. Grains with more 100 grain weight showed less damage which might be due to their boldness and vigor. Tomooka N, *et al*., 2000, found no correlation between seed size and levels of resistance. In current studies, the correlation is weak but positive.

5. Acknowledgement

The research paper is M.Phil study and the author is highly thankful to Dr. Habib Iqbal Javed Ex. PSO, Program leader IPMP for their full cooperation for conducting experiments at IPMP and especially for writing of thesis, that was enable me to get the degree from PARC Institute of advanced studies in agriculture science

6. References

1. Doharey RB, Katiyar RN, Singh KM. Ecotoxicological studies on pulse beetles infesting green gram. Bulletin of Grain Technology. 1983; 21:110-114.
2. Haqqani A, Zahid MA, Zubair M. Present scenario, production constraints and future vision of pulse crops in Pakistan, NARC Islamabad, 2007.
3. Ahmed M. Grain storage management. Newsletter. University of Agriculture Faisalabad, 1995; 2:1.
4. Parsai SK, Rawat RR, Choudhary RK. Ovipositional behaviour and preference of *Callosobruchus phaseoli* (Gyllehal.): its extent of damage in storage seeds of different varieties of field bean. Bulletin of Grain Technology. 1989; 27(2):103-106.
5. Clement SL, E1-DinSharaf N, Weigand S, Lateen SS. Research achievements in plant resistance to insect pests of cool season food legumes. Euphytica. 2004; 73(1, 2):41-50.
6. Demanyk JD, Whiteand NDG, Jays DS. Storage of chickpea. In: Yadav, S.S. R, Redden. Chen W, Sharma B, editors. Chickpea Breeding and Management. CAB International. 2007, 538-554.
7. Sharma HC, Gowda CLL, Stevenson PC, Ridsdill-Smith TJ, Clement SL, Rao GVR *et al*., Host plant resistance and insect pest management. In: Yadav S.S., Redden R., Chen W., Sharma B., editors. Chickpea Breeding and Management. CAB International. 2007, 520-537.
8. Faruk K, Varol I, Bayram M. The effect of carbon dioxide at high pressure under different developmental stages of *Callosobruchus maculatus* (F.) hosting on chickpea. African Journal of Biotechnology. 2011; 10(11):2053-2057.
9. Weigand S, Pimbert MP. Screening and selection criteria for insect resistance in cool-season food legumes. In K.B. Singh, and M.C. Saxena (ed.). Breeding for Stress Tolerance in Cool Season Food Legumes. John Wiley and Sons Publishing, London, UK. 1993, 145-156.
10. Golnaz S, Hassan M, Iman S. Insecticidal effect of diatomaceous earth against *Callosobruchu smaculatus* F. under laboratory condition. African Journal of Agricultural Research. 2011; 6(24):5464-5468.
11. Shamas MR, Afzal M. Effect of synthetic pyrethroids/ organo-phosphate on maize shoot fly; *Atherigona soccata* (Rond.) and maize borer, *Chilo partellus* (Swin.). Journal of Agricultural Research. 1989; 27:65-70.
12. Raynolds HT. Current pest control problems of cotton in the South Westren United States. International Pest Control. 1970, 14-17.
13. Raina AK. Comparative resistance to three species of *Callosobruchus* in a strain of chickpea (*Cicer arietinum* L.). Journal of Stored Products Research. 1971; 7(3):213-214.
14. Dahms RG. Techniques in the evaluation and development of host plant resistance. Journal of Environmental Quality. 1972; 1:254-259.
15. Khattak SUK, Hamed M, Khatoon R, Mohammad T. Relative susceptibility of different moongbean varieties of pulse beetle, *Callosobruchus maculatus* (F.) Journal of stored products Research. 1987; 23:139-142
16. Khattak SU, Munaf A, Khalil SK, Hussain A, Hussain N. Relative susceptibility of wheat cultivars to *Sitotroga cerealella* (Oliv.). Pakistan Journal of Zoology. 1996; 28(2):115-118.
17. Srinivasan T, Durairaj C. Studies on the relative resistance of some promising accessions of green gram, *Vigna radiata* L. Wilczek against the pulse beetle, *Callosobruchus maculatus* Fabricius**.** Research on Crops. 2007; 8(3):680-685.
18. Shaheen FA, Khaliq A, Aslam M. Resistance of chickpea (*Cicer arietinum* L.) cultivars against pulse beetle. Pakistan Journal of Botany. 2006; 38(4):1237-1244.
19. Singh DP, Sharma SS. Studies on weight loss in different genotypes of moong and mash during storage caused by *Callosobruchus maculates* Fab. (Coleoptera: Bruchidae). Bulletin of Grain Technology. 1981; 19:194-197.
20. Siddiqa A, Perveen F, Naz F, Ashfaque M. Evaluation of resistance in local chickpea varieties against the pulse beetle, *Callosobruchus chinensis* L. (Coleoptera: Bruchidae). Pakistan Entomologist. 2013; 35(1):43-46.
21. Tomooka N, Kashiwaba K, Vaughan DA, Ishimoto M, Egawa Y. The effectiveness of evaluating wild species: searching for sources of resistance to bruchid beetles in the genus *Vigna* subgenus *Ceratotropis***.** Euphytica. 2000; 115(1):27-41.