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Difference in Susceptibility of Local and Introduced Chickpea Genotypes to Leafhopper, *Orosius orientalis* Vector of *Chickpea chlorotic dwarf virus* Under Field Conditions, Sudan

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Abstract **– Leafhopper, *Orosius orientalis* which transmitting *Chickpea chorotic dwarf virus* (CpCDV) has become major insect pest constraint chickpea productivity in the Sudan. Hence, some of local and introduced chickpea genotypes were screened in this study against leafhopper and stun disease incidence and chickpea yield under field conditions at Hudeiba Research Station Farm in the River Nile State, Sudan. The experiment was conducted during the two winter Seasons 2014/015 and 2015/016. Treatments were assigned in a randomized complete block design with three replications.**

The results showed that, genotypes Hawata, Burgaig, Mattama, Flip04-9c, Flip03-127c and Jabel Marra were recorded more tolerant, than the introduced genotypes, Flip03-107, Flip04-1c, Flip03-110c, Flip03-102c and Flip03-104c, which were recorded high susceptibility to leafhopper and stunt disease incidence. Regarding of seed yield, cultivar Hawata gave the highest seed yield (2071.5kg/ha) followed by Mattama (1876.0 kg/ha) and Burgaig (1766.8 kg/ha).

Keywords **– Chickpea, Genotypes, *Cicer Arietinum*, Leafhopper, Stunt Disease and Plant Resistance.**

I. INTRODUCTION

The chickpea (*Cicer arietinum* L.) is the third important grain legume in the world after common bean (*Phaseolus vulgaris* L.) and dry pea (*Pisum sativum* L.). Most chickpea producing areas are located in the arid and semi-arid zones, and approximately 90% of world's chickpea is grown under rain fed conditions [6]. It is cultivated across the world in the Mediterranean Basin, the Near East, Central and South Asia, East Africa, South America, North America and Australia [8]. The total cultivated area worldwide was estimated at about 14 million hectare s producing 13 million tons [2]. Chickpea seeds contain high protein 13-33, carbohydrate 40-55% and some essential minerals and vitamins. Moreover, chickpea fixes about 140 kg N/ha from the atmosphere through symbiosis with Rhizobium bacteria and therefore, is a suitable rotational crop especially in cereal based cropping systems [3].

In Sudan, chickpea faces competition with other winter legumes such as faba bean and common bean as well as other cash crops like spices. The major cultivated area is concentrated in the northern region of Sudan on basins and Islands along the River Nile and some small areas at Hawata and Jabel Marra. More recently, chickpea cultivation is extended to the central Sudan especially in the irrigated Gezira Scheme and New Halfa. In Sudan, it is either irrigated or utilizes the residual moisture stored in the soil after the River Nile flood recedes. Average area grown with this crop in the River Nile State for the period 2003-2012 was about 5500 ha with an average yield of 1.5 tha−1 [1]. Average yields of chickpea in farmer's fields in northern and central Sudan are considerably lower than potential yields obtained at research stations. This gap points to considerable opportunities for productivity gains by alleviating production constraints. Insect pests such as gram pod borers, *Helicoverpa armigera* (Hub.) (Lepidoptera: Noctuidae), and *Orosius orientalis* (Homoptera: Cicadellidae), which transmitting *Chickpea chorotic dwarf virus* (CpCDV), and wilt/root rot diseases (*Fusarium oxysporum f.sp. ciceris*/*Rhizoctonia bataticola*), are major biotic constraints to chickpea productivity in the Sudan. The *Chickpea chlorotic dwarf virus* (CpCDV, genus *Mastervirus,* family *Geminiviridae*) is commonly found in Pakistan, Iran and Sudan [7]. CpCDV can cause stunting, internodes shortening, phloem browning in the collar region and leaf reddening in desi-type while yellowing in kabuli-type chickpea varieties [4]. It nearly caused 100% yield loss of individual plants when infection occurred before flowering and 75–90% losses when infection occurred during flowering [5].

For the management of the vector of disease several control options available such as cultural practices, planting resistant cultivars and chemical control. Host plant resistance is considered the most desirable control methods it is sustainable way, more effective and environment friendly than the use of chemicals. Hence, the objective of this study was to evaluate different local and introduced chickpea genotypes against *Orosius orientalis*, and stunt disease incidence and chickpea yield under field conditions.

II. MATERIALS AND METHODS

The experiment was carried out under irrigation for two winter seasons (2014/015 and 2015/016) at Hudeiba Research Station farm, River Nile State, Sudan. The site is located at latitude 17.57º N, Longitude 33.93º E, and elevation 350 m above sea level. The climate is semi desert, very hot and dry in summer and relatively cool and short in winter (November to February). Eighteen chickpea genotypes (ten advanced chickpea provided by ICARDA and eight released varieties) were grown in a randomized complete block design with three replicates. In both seasons chickpea seeds were sown on 18/11/2014 and 15/11/2015,

respectively. The plot size was 4×5 m and spacing of 0.6 m between rows. The seeds were planted on ridge at 10 cm between holes. All cultural practices as recommended by ARC were adopted under pesticides–free conditions. The crop was fertilized once with 1N fertilizer. To assess the incidence of leafhopper, five plants were taken randomly from each plot, and number of leafhopper was counted. Assessment of plants infection by (CpCDV) was made by counting all plants in the two inner rows in each plot counted and expressed in percentage of disease incidence by using the following equation:

$$\text{Percent of diseases incidence} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

At harvesting time, the two outer most rows as well as 100cm from both ends of each plot were considered as margins. Seed yield was taken from area 9.6 m², and then calculated as kg/ha. The data was analyzed after transformation. MSTATC software program was used for analysis of variance (ANOVA) and Duncan's multiple range test DMRT) was used for means separation.

III. Results and Discussion

The tested genotypes of chickpea in season 2014/015 differed significantly (P≤0.05) in the number of leafhopper, percent disease incidence and seed yield (Table 1). High infestation with leafhopper was recorded on Flip03-110c, Atmore, Selwa, Flip03-104c and Flip03-102c, and slightly lower infestation on Flip03-139c followed by Flip04-10c, Jebel Marra, Burgaig and Mattama. However, the lowest number of leafhopper was recorded on Flip04-9c followed by Flip03-127c and Hawata. The highest Percent of disease incidence (18.5%) was recorded on Flip03-127c followed by (13.3%) with Flip04-1c, (12.9%) with Flip03-110c, (12.5%) with, Flip03-102c and (12.2%) on Flip03-104c whereas, the lowest percent of disease incidence was recorded on Hawata (3.3%) followed by Burgaig, (4.3%), Mattama (5.8%), Flip04-9c (5.9%), Flip03-127c (6.1%), Jabel Marra (6.5%) and Flip03-139c (6.7%). Cultivar Mattama gave the highest seed yield (1984.8 kg/ha) followed by Hawata (1793.8kg/ha), Jabel Marra (1738.6 kg/ha) and Burgaig (1582.9 kg/ha) while, the lowest yield was recorded with genotypes, Flip04-30c (671.9 kg/ha) followed by Flip03-102c (802.1 kg/ha) and Flip03-107c (936.7 kg/ha).

Table 2 showed that, number of adult's leafhopper, percent of disease incidence and seed yield of the tested chickpea genotypes were ranged between 1.2-2.7 adults, 3.1 16.2%, and 289.5-2071.5kg/ha respectively. The high infestation (2.7 adults/5plants) was recorded on cultivar Selwa and the lowest number of adult leafhopper (1.2 adults/5plants) was recorded on Hawata. Genotypes, Flip03-104c, Selwa, Flip03-110c, Flip03-107c and Flip04-1c showed the highest percent of disease incidence, whereas, the cultivars Flip03-127c, Mattama, Hawata, Jabel Marra and Burgaig were recorded the lowest percent of disease incidence. The highest seed yield was obtained by Hawata (2071.5 kg/ha) followed by Mattama (1876.0 kg/ha) and Burgaig (1766.8 kg/ha), and the lowest seed yield (289.5 kg/ha) was obtained by Flip03-107c. The results of both years indicated that all genotypes tested were none completely free from leafhopper and stunt disease incidence. Population of leafhopper and stunt disease incidence in local varieties was lower than the introduced genotypes; this indicated that the local varieties show the potential threat of the pest. The lowest number of leafhopper and stunt disease incidence in local varieties suggests that these have already genetically adapted to the vector of the virus disease.

IV. Conclusion

Based on the obtained results it can be concluded that the introduced genotypes; Flip03-107, Flip04-1c, Flip03-110c, Flip03-102c, Flip03-104c and Flip04-30c were recorded higher susceptibility to leafhopper and stunt disease incidence than the slightly lower damage on Hawata, Burgaig, Mattama, Flip04-9c, Flip03-127c and Jabel Marra. Therefore, it is suggested that those genotypes could be exploited by development of resistant germplasm by using them in hybridization. Local cultivars Hawata, Burgaig, Mattama and Jabel Marra, which were found tolerant to the leafhopper and stunt disease incidence is suggested to be grown in the areas where the high infestation of the pest was historically recognized.

REFERENCES

[1] Alla Jabow, M.K., Ibrahim, O.H. and Adam, H.S. (2015). Yield and Water Productivity of Chickpea (*Cicer arietinum* L.) as Influenced by Different Irrigation Regimes and Varieties under Semi Desert Climatic Conditions of Sudan. *Agricultural Sciences*, 6, 1299 - 1308. http://dx.doi.org/10.4236/as.2015.611124

[2] FAO. (2013). Chickpea production. Food and Agricultural Organization, year book.

[3] Gan, Y.T. P.R., Miller, B.G.MC. Conkey, R.P. Zentener, P.H. Liu and C.L.MC. Donal. (2010). Optimum pant production density for chickpea and dry pea in a semi aired environment. Field Crop Research. Vol. 17: 32-4.

[4] Horn N.M., S.V. Reddy, I.M. Roberts and D.V.R. Reddy. (1993). Chickpea chlorotic dwarf virus, a new leafhopper- transmitted gemini virus of chickpea in India. *Annals of Applied Biology* 122, 467–479.

[5] Horn N.M, S.V. Reddy, J.F.J.M. van den Heuvel and D.V.R. Reddy. (1996). Survey of chickpea (*Cicer arietinum* L.) for chickpea stunt disease and associated viruses in India and Pakistan. *Plant Disease* 80, 286– 290.

[6] Kumar, J. and Abbo, S. (2001). Genetics of Flowering Time in Chickpea and its Bearing on Productivity in Semiarid Environments. In: Spaks, D.L., Ed., *Advances in Agronomy*, Vol. 2, Academic Press, New York, 122-124.

[7] Makkouk, K. M., Kumari, S. G., Huges, J. D. A., Muniyappa, V., & Kulkarni, N. K. (2003). Virus and virus- like disease of major legumes crops in developing countries, In G. Loebenstein, & G. Thottappilly (Eds.), pp. 447–476. Dordercht: Kluwer Academic Publisher.

[8] Soltani, A., Hammer, G.L., Torabi, B., Robertsonc, M.J. and Zeinali, E. (2006). Modeling Chickpea Growth and Development: Phenological Development. *Field Crops Research*, 99, 1-13. http://dx.doi.org/10.1016/j.fcr.2006.02.004

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Previous publications:

1. Ali, A. E., Mohamed, H. A., Hamed, K. E., El Habieb, R. Y. and Zorgani, M. G. (2017) Evaluation of Celest Top® 312.5 FS (fludioxonil 25g/L; difenoconazole 25g/L; thiamethoxam 262g/L) to control insect pests and seedling diseases on wheat, Sudan. J. basic appl. Res 3 (3): 97-100.
2. Hamed, K. E. and Ali, A. E. (2017). Evaluation of the Efficacy of Apron Star 42 WS as Seed Dresser against Seed bed Diseases and Insect Pests on Wheat. Journal of Agricultural and Veterinary Sciences, Qassim University, Vol. 10, No. 1, pp. 41-50 (January 2017/Rabi II 1438H)
3. Mansour, A. E. A. and Mohamed, A. A. (2014) Evaluation of Different Chickpea Genotypes for Resistance against Pod Borer, *Helicoverpa armiger* (Hub.) (Lepdoptera: Noctuidae) under Field Conditions, Sudan. International Journal of Agriculture Innovations and Research, Volume 2, Issue 6, ISSN (Online) 2319-1473.
4. Mansour, A. E. A. and Seed Ahmed, S. (2014). Screening of some sorghum genotypes for resistance to sorghum midge, *Stenodiplosis sorghicola* (Coq), under rain-fed conditions, Sudan. International Journal of Agriculture Innovations and Research, Volume 2, Issue 6, ISSN (Online) 2319-1473.
5. Mansour, A. E. A. and Mohmoud, M. E. E. (2014). Effects of Sowing Dates and Sorghum Varieties on The Incidence of Sorghum Midge, Stenodiplosis sorghicola (Coq) at Abu-Naama, Sudan. Persian Gulf Crop Protection Journal, ISSN: 2251-9343 (online), Vol. (3), Issue 1, March 2014. Pp. 88-91.
6. Ali, A. E. and Ali, A. B. (2013). The Biology and Food Consumption of the African Bollworm *Helicoverpa armigera* (Hub.) on Sunflower at Gedarif, Sudan. Journal of Science and Technology Vol. 14, Journal of Agricultural and Veterinary Sciences (JAVS No.2). Khartoum, Sudan. pp. 54-60.
7. Ali, A. E. and Ali, A. B. (2013). Effects of some sunflower varieties on the incidence of the African bollworm*) Helicoverpa armigera* Hub.) (Lepidoptera: Noctuidae) at Gedarif rain fed area, Sudan. Sudan Journal Agric. Res. (2013), Agricultural Research Corporation (ARC), Wad Medani, Sudan Pp. 139-144.

Table 1. Mean number of leafhopper, percent of stunt disease incidence and seed yield on different chickpea genotypes at Hudieba Sudan, season 2014/015.

Genotype	No. of leafhopper/5plants	% stunt of disease incidence	Seed yield (kg/ha)
Flip03-139c	1.2 (1.1) abc	(6.7) abcd	(1321.9) h
Flip04-30c	1.4 (1.6) bcd	(11.6) cde	(671.9) m
Flip03-102c	1.5 (1.8) cd	(12.5) cde	(802.1) l
Flip03-127c	1.0 (0.7) ab	(6.1) abc	(1402.1) g
Flip04-9c	1.0 (0.5) a	(5.9) abc	(1481.9) ef
Flip03-104c	1.6 (2.0) cd	(12.2) cde	(1457.9) f
Flip03-107c	1.4 (1.6) bcd	(18.5) e	(936.7) k
Flip03-110c	1.6 (2.1) d	(12.9) de	(1058.8) j
Flip04-1c	1.5 (1.8) cd	(13.3) de	(1531.9) de
Flip04-10c	1.2 (1.1) abc	(8.4) bcd	(1026.2) j
Atmore	1.7 (2.3) d	(9.6) cd	(1212.4) i
Shandi	1.3 (1.3) abcd	(8.4) bcd	(1214.4) i
Jabel Marra	1.2 (1.1) abc	(6.5) abc	(1738.6) c
Hawata	1.0 (0.7) ab	(3.3) a	(1793.8) b
Burgaig	1.3 (1.3) abcd	(4.3) ab	(1582.9) d
Mattama	1.3 (1.3) abcd	(5.8) abc	(1984.8) a
Selwa	1.5 (1.8) cd	(8.4) bcd	(1439.8) fg
Wad Hamed	1.5 (1.8) cd	(9.6) cd	(1433.3) fg
SE±	0.194*	0.301**	7.478**
C.V%	17.5	17.4	18.0

Actual figures between bracts, Transformed data according to √x+0.5
Means followed by the same letter (s) with the same column are not significantly different at 0.05 and 0.01 level of probability according to Duncan Multiple Range Test (MRT) respectively. n.s = non- significant.

Table 2 .Mean number of leafhopper, percent of stunt disease incidence and seed yield on different chickpea genotypes at Hudieba, season 2015/016.

Genotype	No. of leafhopper/5plants	% stunt disease incidence	Seed yield (kg/ha)
Flip03-139c	1.6 abcd	6.3 abc	890.4 def
Flip04-30c	2.4 de	8.1 bcd	873.6 def
Flip03-102c	2.2 bcde	8.8 bcd	1125.0 cde
Flip03-127c	1.4 ab	3.1 a	1553.1 abc
Flip04-9c	1.5 abc	7.9 abcd	947.5 def
Flip03-104c	2.2 bcde	16.2 g	487.8 fg
Flip03-107c	2.0 abcde	12.9efg	289.5 g
Flip03-110c	2.3 cde	13.3 efg	456.7 fg
Flip04-1c	2.3 cde	11.9 defg	422.9 fg
Flip04-10c	1.8 abcd	6.8 abc	925.7 def
Atmore	2.3 cde	9.9 cdef	1392.1 bcd
Shandi	1.8 abcd	7.6 abcd	717.2 efg
Jabel Marra	1.7 abcd	5.8 abc	1696.9 ab
Hawata	1.2 a	4.9 ab	2071.5 a
Burgaig	1.7 abcd	5.1 ab	1766.8 ab
Mattama	1.5 abc	4.7 ab	1876.0 ab
Selwa	2.7 e	14.2 fg	968.7 def
Wad Hamed	1.5 abc	7.8 abcd	1442.1 bcd
SE±	0.418*	1.461**	178.1**
C.V%	26.9	29.3	27.9

Means followed by the same letter (s) with the same column are not significantly different att 0.05 and 0.01 level of probability according to Duncan Multiple Range Test (MRT) respectively.

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