WATERMELON BREEDING FOR ROOT-KNOT NEMATODE RESISTANCE (*Meloidogyne incognita*)

By

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ABSTRACT

This study was conducted in research facilities of the Vegetable Crops Department and Department of Zoology and Agricultural Nematology, Faculty of Agriculture, Cairo University and Horticultural Research Institute during the period from 2010 to 2016 to evaluate 21 genotypes of *Citrullus* spp**.** for level of resistance to root-knot nematode (RKN), *Meloidogyne incognita*, to evaluate selected genotypes and their intervarietal hybrids, and to identificate nature and inheritance of RKN resistance. The evaluation results showed that the five citron PIs 482303, 482379, 270563, 482338 and 500347 of *C. lanatus* var. *citroides* had the highest resistance level against *M. incognita*, while the cultivated varieties Sugar Baby, Charleston Gray 133 and Giza 1 were reacted as susceptible hosts to *M. incognita*.

Based on these results, the five resistant accessions (*C. lanatus* var. *citroides*) (as male parents) were crossed with the three cultivated watermelon varieties, Sugar Baby, Giza 1 and Charleston Gray 133 (as female parents) in one direction. These 15 F_1 hybrids and their parents were evaluated along with the F_1 hybrid Aswan as a control during the 2015 and 2016 summer seasons under pot conditions and natural infection in infested and non infested fields. Results showed that the citron PIs 482303 and 482379 were good sources of resistance against the RKN, *M. incognita* for the development of resistance in watermelon cultivars. The crosses Sugar Baby × PI 482303, Sugar Baby × PI 482379 and Charleston Gray 133 × PI 482379 were rated as resistant hosts against the RKN. The results of histopathological study showed that resistance to *M. incognita* in resistant genotypes (PI 482303 and F_1) was associated with retardation of nematode development and hypersensitive necrosis as compared to susceptible genotype (Sugar Baby). This retardation in resistant genotypes was due to that giant cells in the resistant genotypes were small, few, poorly and abnormally developed compared to the susceptible parent. The biochemical analysis results revealed that the level of peroxidase, polyphenol oxidase and phenyl alanine ammonia lyase activities and total phenols content in the inoculated resistant F_1 hybrid reached, approximately, to 2.5, 1.5, 3.5 and 4 folds, respectively, while in the inoculated resistant parent reached, approximately, to 2, 3.1, 3 and 3 folds, respectively, compared to the inoculated susceptible parent. The obtained results of genetic study of populations of the hybrid Sugar Baby × PI 482303 showed complete and partial dominance of the resistant parent over susceptible one for galls and egg mass numbers, respectively. The resistance to the RKN infection was found to be controlled by one pair of dominant genes for each of galls and egg mass numbers. The heritability in broad and narrow sense of galls number were high, being 90.04 and 78.45%, respectively, and of egg masses number were 84.25 and 61.70%, respectively. It was evident, from this study, that PI 482303 (*C. lanatus* var. *citroides*) is a good source for the development *M. incognita* resistance in watermelon.

Key words: Watermelon, Citron, Evaluation, *Meloidogyne incognita*, Resistance, Inheritance, Heritability.

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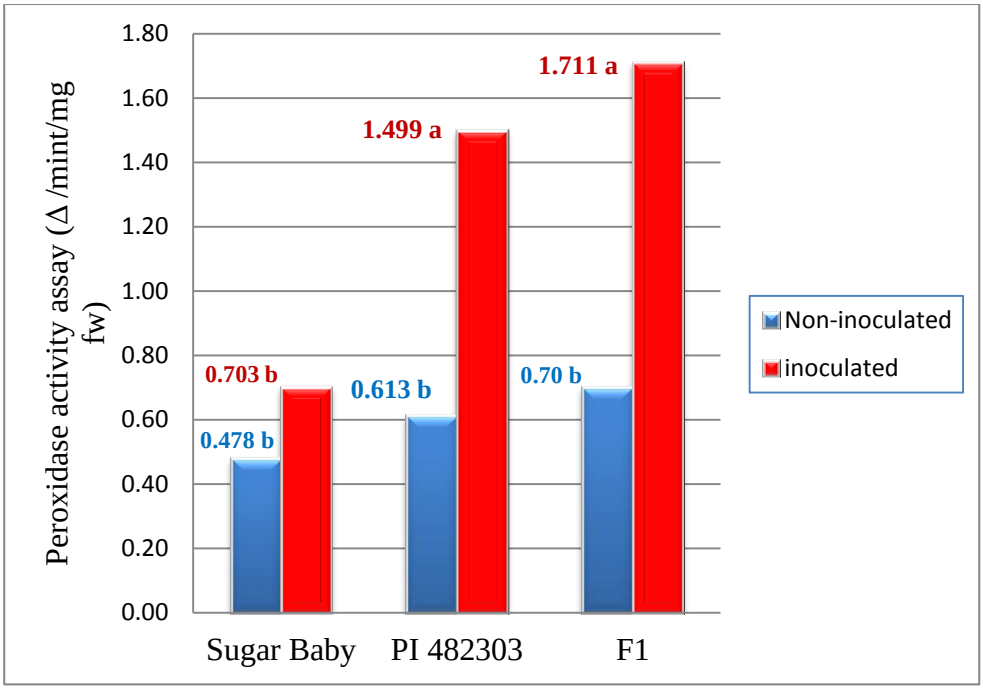

Fig. 8. Activity of peroxidase enzyme in inoculated and non-inoculated plant roots of susceptible parent cv. Sugar Baby, resistant parent PI 482303 and their F_1 hybrid.

482303) reached, approximately, to 2.5 and 2 folds, respectively, higher than that of the inoculated susceptible parent (Sugar Baby).

The above mentioned findings are closely similar with those obtained by Arrigoni *et al*. (1981), Zacheo *et al*. (1982 and 1983), Bajaj *et al* (1985), Ganguly (1985), Zacheo *et al*. (1988), Melillo *et al*. (1992), Zacheo *et al*. (1993), Rajasekhar *et al*. (1997), Rani *et al*. (2008), Kalaiarasan (2009), Mahdy and Midan (2011), Chawla *et al*. (2013), Kaur *et al*. (2013), Dhivya *et al*. (2016), Lobna *et al*. (2017) and Ye *et al*. (2017) who reported that PO activity of all the cellular components was increased in the resistant genotypes compared with susceptible ones of most of main vegetable crops after infection with RKNs especially *M. incognita*. On the contrary, they reported that no

يتبين من نتائج هذه الدراسة أن السلالة PI 482303 التى تتبع *C. lanatus* var. *citroides* تعتبر مصدراً جيداً لتحسين المقاومة لنيماتودا تعقد الجذور *M. incognita* فى البطيخ.

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المستخلص العربي

أُجريت هذه الدراسة فى قسم الخضر وقسم الحيوان والنيماتولوجيا الزراعية – كلية الزراعة – جامعة القاهرة ومعهد بحوث البساتين خلال الفترة من ٢٠١٠ إلى ٢٠١٦ وشملت تقييم لعدد ٢١ تركيبا وراثيا من *Citrullus* spp. للمقاومة لنيماتودا تعقد الجذور *Meloidogyne incognita*، و كذلك تقييم للتراكيب الوراثية المنتخبة والهجن الناتجة منها، ودراسة طبيعة ووراثة المقاومة لنيماتودا تعقد الجذور *M. incognita*. أظهرت النتائج أن خمس سلالات تتبع *Citrullus lanatus* var. *citroides* وهي PI 482303 ،وPI 482379 ،وPI 270563 ،وPI 482338 ،و PI 500347 أظهرت مقاومة عالية لنيماتودا تعقد الجذور بينما أظهرت الأصناف التجارية المنزرعة Sugar Baby و Charleston Gray 133 و Giza 1 قابلية للإصابة.

بناءا علي هذه النتائج تم التهجين بين السلالات الخمسة المقاومة (إستخدمت كآباء) مع ثلاثة اصناف بطيخ تجارية وهي Sugar Baby ،و Giza 1 ،و Charleston Gray 133 (إستخدمت كأمهات) فى إتجاه واحد. قيمت هذه الهجن الخمسة عشر بالاضافة إلي آبائها وكذلك هجين قياسي (أسوان) فى العروة الصيفية خلال عامي ٢٠١٥ ،و ٢٠١٦ في الصوبة في أصص الزراعة باستخدام العدوي الصناعية. كذلك قيمت هذه التراكيب الوراثية تحت ظروف العدوي الطبيعية في حقل موبوء وقُيمت في نفس الوقت في حقل سليم (كنترول). وقد أظهرت النتائج أن السلالات PI 482303 ،و PI 482379 كانت مصادر جيدة لمقاومة نيماتودا تعقد الجذور *M. incognita*، و يمكن إستخدامها فى تحسين المقاومة للنيماتودا فى أصناف البطيخ التجارية. و كذلك أظهرت الهجن Sugar Baby × PI 482303 ،و Sugar Baby × PI 482379 ،و Charleston Gray 133 × PI 482379 مقاومة عالية لنيماتودا تعقد الجذور.

أظهرت نتائج الدراسة الهستولوجية أن مقاومة النيماتودا في التراكيب الوراثية المقاومة (السلالة PI 482303 والهجين Sugar Baby × PI 482303) ترتبط بتأخير وإعاقة تطور النيماتودا وتفاعل فرط الحساسية. وهذا التأخر في التطور في التراكيب الوراثية المقاومة يرجع إلي أن الخلايا العملاقة صغيرة الحجم وقليلة العدد وضعيفة التطور مقارنة بالأب القابل للإصابة (Sugar Baby).

أظهرت النتائج أيضا أن مستوى نشاط انزيمات البيروكسيديز، والبولي فينول أكسيديز، والفينيل ألانين أمونيا ليز، والمحتوى الكلى للفينولات فى الهجين المقاوم المعدى بالنيماتودا وصل تقريباً إلى ٢,٥ ،و ١,٥ ،و ٣,٥ ،و ٤ أضعاف، على التوالى، مقارنة بالأب الحساس المعدى (Sugar Baby)، كذلك وصل مستوي نشاط هذه الإنزيمات فى الأب المقاوم المعدى (PI 482303) تقريباً إلى ٢ ،و ٣,١ ،و ٣ ،و ٣ أضعاف، على التوالى، مقارنة بالأب الحساس المعدى (Sugar Baby).

أظهرت نتائج الدراسة الوراثية المتحصل عليها من العشائر الوراثية للهجين Sugar Baby × PI 482303 وجود سيادة تامة للأب المقاوم على الأب الحساس بالنسبة لعدد العقد لكل جذر نبات، كذلك وُجدت سيادة جزئية للأب المقاوم على الأب الحساس بالنسبة لعدد كتل البيض لكل جذر نبات، كما وُجد أن مقاومة نيماتودا تعقد الجذور فى البطيخ يتحكم فيها زوج واحد من العوامل الوراثية السائدة وذلك لصفتى عدد العقد وعدد كتل البيض لكل جذر نبات. كذلك كانت درجة التوريث على النطاق العريض ،و الضيق لعدد العقد لكل جذر نبات مرتفعة، حيث كانت ٩٠,٠٤ و ٧٨,٤٥ %، على التوالى، ايضاً كانت لعدد كتل البيض لكل جذر نبات للنطاق العريض ٨٤,٢٥ % ،و للنطاق الضيق ٦١,٧٠ %.

يتبين من نتائج هذه الدراسة أن السلالة PI 482303 التى تتبع *C. lanatus* var. *citroides* تعتبر مصدراً جيداً لتحسين المقاومة لنيماتودا تعقد الجذور *M. incognita* فى البطيخ.

الكلمات الدالة : البطيخ ، نيماتودا تعقد الجذور، طبيعة المقاومة، الوراثة، درجة التوريث.