Genetic studies on some tomato hybrids performance under low temperature conditions

Zeinab I. M. Elsaka

Three experiments were conducted in the ”AgriculturalExperimental STation” and the ”Preservation and utilization or PrimitiveGennplasm Laboratory”; Department of Horticulture; Faculty ofAgriculture at Moshtohor, zagazig University; Benha Branch, during theperiod 1993 to 1996 to study the inheritance of cold tolerance of tomatoat three different phases i.e. germination, seedling, and adult plant stages.Experiment I : Inheritance of genninability under low temperature:Seeds of the parental genotypes Super Marmand and Castle Rock,and F2 population of the cross Super Marmand x Castle Rock were usedin this experiment which was conducted according to the randomizedcomplete block design with two replicates. Each replicate contained onegroup of seeds from each of the parental genotypes and 58 groups of seedsfrom F2 population, whereas each group contained SO seeds wereincubated at 8 + l°C inside an incubator. The results of this experimentcan be summarized as follows:1. Genetic differences between the parental cultivars Super Marmandand Castle Rock were detected concerning germinability under lowtemperature, where the c.v. Super Marmande was superior in thisrespect.::f. Low temperature germinability, wheather measured as germinationpercentage or germination rate, was found to be inheritedquantitatively.3. Partial dominance for low germination percentage and lowgermination rate under low temperature conditions was observed.4. The broad sense heritability estimates for low temperaturegermination ranged from low to above intermediate indicating theinvolvement of environmental effects on the inheritance of thischaracter.Experiment 2: Inheritance 01seedllng • cold tolerance:Seedlings of the parental cultivars Super Marmande and CastleRock, and seedlings of the FI and F2 populations of the cross SuperMarmande x Castle Rock were exposed to a temperature of 8° + 2°e anda photoperiod of 14 hours for 12 days to study the inheritance of seedlingcoldtolerance. Seedlings which survived the low temperature conditionsduring this period were considered tolerant while those showed leaf bumsand/or died were considered suscepetabile. The results of this experimentcan be summerized as follows:1. Seedlings of the parental genotype Super Marmande survived thelow temperature which exposed to. However, seedlings of theparental genotype Castle Rock did not survive this temperature andbegan to bum and/or wilt.2. Tolerance of seedlings to low temperature conditions showedqualitative inheritance pattern.3. Tolerance of seedlings to low temperature was found to becontrolled by one recessive gene pair (r r).Experiment ill. Inheritance of adult plant tolerance to lowtemperaturePlants of the different populations (Pb P2, Fb F2’ Be1and BC2) ofthe crosses Super Mannande XCastle Rock, DC 97-3 X SuperMarmande, Line # 3 X Super Mannande, and Super Mannande XFloradade were evaluated in the field for cold tolerance under an averagetemperature of 20.9°C day and 9.1°C night during November 1994 ,December 1994 , and January 1995. The results of this experiment canbe summerized as follows:1. Genetic differences were detected among the different parentalgenotype concerning cold tolerance of adult plants evaluated bydifferent measurements where the c.v, Super Mannande was thesuperior to other parental cultivars/line in this respect.2. High level of foliage cold tolerance was partially dominant overthe low level.3. Absence of dominance for earliness of flowering under lowtemperature conditions was revealed.4. The high percentage of fruit set under low temperature showedpartial dominance over the low percentage of fruit set.5. Partial dominance for low yield/plant under cold conditions wasobserved over high yield/plant under such conditions.6. Foliage cold

tolerance, fruit set, total yield/plant under lowtemperature in the field showed quantitative inheritance pattern.7. Earliness of flowering under low temperature conditions showedqualitative inheritance pattern.818. Non of the Fi hybrids showed better parent heterosis concerningfoliage cold tolerance, low temperature fruit set, and totalyield/plant under low temperature conditions. However, mid-parentheterosis was observed for foliage cold resistance in the crosses.Super Marmande X Castle Rock (39.44%) and UC 97-3 X SuperMarmande (17.41%), for low-temperature fruit set in the crossesSuper Marmande X Castle Rock (30.10%), UC 97·3 X SuperMarmande (62.72%), and Super Marmande X Floradade (4.83%),and for total yield/plant in the cross UC-97 -3 X Super Marmande(19.46%).9. Transgressive segregatiocs for foliage cold tolerance were observedin the F:zpopulations of the crosses Super Marmande X Castle Rockand Line # 3 X Super Marmande and in the BCl population of thecross Line # 3 X Super Marmande indicating that the involvedparental genotypes possess different genes controlling foliage coldtolerance.10. Relatively, high frequency of transgressive regregation for highpercentage of fruit set under low temperture conditions wereobserved in the F:zpoulations of all crosses.11. The broad sense heritability estimates for foliage cold tolerancewere 91.23%, 82.45, 74.69%, and 75.93% while the estimates ofthe narrow sense heritability were 45.19%, 77.60, 24.18%, and 5.07for the crosses Super Marmande X Castle Rock, UC 97-3 X SuperMarmande, Line # 3 X Super Marmande, and Super Marmande XFloradade, respectively.12. The broad sense heritability estimates for the ability of tomatoplants to set fruits under low temperture conditions were 96.21 %,95.28%, 93.72%, and 96.4% for the crosses Super Mannande XCastle Rock, DC 97·3 X Super Marmande, Line # 3 X SuperMannande, and Super Marmande X Floradade, respectively.13. The broad sense heritability estimates for total yield per plant were52.63%, 52.34%, 68.74%, and 25.95% for the crosses SuperMannande X Castle Rock, DC 97-3 X Super Marmande, Line # 3X Super Mannande, and Super Mannande x Floradade,respectively.14. Number of major effective genes controlling foliage cold tolerance,percentage of fruit set under low temperature conditions, and totalyield/plant under low temperature were 1-2, 1, 3-39 gene pairs,respectively.15. Earliness of flowering under low temperature condition wascontrolled by one gene pair. The genotype of the late floweringplant will be LL while that of the early flowering will be 11.Due tothe absence of dominance and possible additive effect, thegenotype L1 will give an intermediate flowering phenotype.16. Significant positive correlation was detected between foliage coldtolerance and each of number of branches per plant, percentage offruit set under low temperature conditions, number of fruits perplant, and fruit weight.17. Significant positive correlation was observed between percentageof fruit set under low temperature and number of fruits per plant.18. Significant positive correlation between total Yield/plant under lowtemperature conditions and foliage cold tolerance.19. Significant positive correlations between cold tolerance of adultplant foliage and the studied chemical characteristics of fruits i.e.vitamin C content, juice acidity, and total sugars content.20. The combined effect of plant yield, percentage of fruit set under lowtemperaure, fruit number/plant and fruit length was found to havesignificant linear relationship with plant foliage tolerance to lowtemperature.21. The combined effect of number of fruits per plant and fruit weightwas found to have a significant linear relationship with thepercentage of fruit set under low temperature conditions.22. High number and weight of fruits per plant in addition to low fruitdiameter were found to have a significant combined effect on totalyield per/plant. Furthermore, the combined effect of number offruits/plant, fruit weight, and fruit flesh thickness was highlycorrelated with the amount of total yield/plant.23. No association was observed between number of locules per fruitand degree of foliage cold tolerance.24. Significant association was observed in one of the crosses (line # 3X Super Marmande) between lobulated fruits and high degree offoliage cold tolerance.