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STANDARDIZATION OF ROOTSTOCKS FOR MAJOR DISEASES AND PEST IN SWEET PEPPER (*CAPSICUM ANNUUM* L.)

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ABSTRACT

The present investigation entitled “Standardization of rootstocks for major diseases and pest in sweet pepper (*Capsicum annuum* L.)” was conducted during *khariif*-2022 to study the graft compatibility of two capsicum hybrids with different chilli rootstocks and the effect of rootstocks on the diseases and pests of capsicum. The experiment was laid out in Factorial Randomized Block Design with 3 replications and 16 treatments comprising of seven rootstocks and two scions. There were no significant variations among graft combinations in incidence of fusarium wilt and root knot nematode. Nematite grafted on CRS-7 recorded minimum incidence of chilli mosaic, damping off, leaf curl and thrips. Thus, from the present investigation it can be concluded that Nematite grafted on CRS-7 is suitable graft combination for better growth and yield of capsicum.

Key words : Chilli rootstocks and Scion, Grafting, Diseases and Pests parameters of Capsicum.

Introduction

Capsicum (*Capsicum annuum* L.) is one of the important vegetable crops in India belonging to night shade family Solanaceae. Genus *Capsicum* has diploid chromosome number $2n=2x=24$ while *C. annuum glabriusculum* is tetraploid species ($2n=2x=48$), which is wild form of cultivated pepper (Carrizo *et al.*, 2016). *C. annuum* is used worldwide for vegetable as well as spice purpose. Both the chilli and bell pepper have nutraceutical importance as they contain array of health beneficial compounds such as vitamin A(8493IU), Vitamin B, Vitamin C(283mg) and minerals such as calcium (13.4mg), magnesium (14.9mg), phosphorus(28.3mg) along with the capsaicinoides, capsinoides, phenolics, caretenoides (De, 2003; Jarret *et al.*, 2007 and Carvalho *et al.*, 2015). The capsicum fruits are available in the market throughout the year due to wide range of production throughout the country in all seasons. Production of *Capsicum annuum* is becoming more

challenging day by day due to biotic and abiotic stresses which can limit the marketable yield. Grafting is being evaluated actively as the technology which allow production of pepper in order to expand into regions where pressure of disease and abiotic stress limits the process of production. (Fisk, 2017 and Mamphogoro *et al.*, 2020).

Grafting is the technique which mainly assist to improve agronomic characteristics, abiotic stress resistance, fruit quality and yield as compared to non-grafted plants. (Devi *et al.*, 2020) Grafting is becoming a well-developed practice worldwide with many horticultural advantages. The primary motivation for capsicum grafting has been to prevent the damage caused by soil borne pathogens under intensive production system. The success of grafting depends on the fast formation of vascular bonding between the rootstock and scion with instant emergence of root and canopy growth (Pina and Errea, 2005). Hormones specifically the auxins and cytokinins play main role in the early establishment of the compatible

graft union through grafting. Among different grafting techniques “Splice grafting” technique (also known as “Top grafting”) is widely used for vegetable grafting as it efficient, quicker and easy to practice (Hameed *et al.*, 2021). Formation of vascular connectivity within 5 - 8 days is required for the graft union of herbaceous vegetable plants to develop vascular connection on between rootstock and scion and produce graft (Fernandez *et al.*, 2004).

Generally grafting of vegetable is a technical procedure which is mainly carried out either by manually or mechanically (simple machines or robots) following steps which mainly involved: 1. Selection of the rootstocks and Scion. 2. Application of the method which have been selected for grafting. 3. Healing of the wounded cut surfaces. 4. Grafting success should be evaluated. 5. Grafted seedling should be acclimatized under suitable environmental condition in order to it become stronger for transplantation (Surve, 2019). Grafting represents an effective and efficient tool for controlling the soil borne pathogen survives on plant remains in the soil. Grafting technology also highly efficient in order to improve crop losses which caused by unsuitable environmental conditions such as less soil temperature and high soil salts especially under protected cultivation where sustainable cropping practiced in succession (Lee *et al.*, 2010). Hence, the experiment conducted with an objective to study the compatibility of capsicum cultivar/hybrid grafted on various chilli rootstocks for percent incidence of fusarium wilt, damping off, leaf curl virus, chilli mosaic thrips and root knot nematode.

Materials and Methods

The present investigation entitled “Standardization of rootstocks for major diseases and pest in sweet pepper (*Capsicum annuum* L)” was conducted at the Center of Excellence for vegetables, Krishi Vigyan Kendra, Baramati. The present investigation was conducted in the *kharif*-2022 (June-September). The experiment was laid out in Factorial Randomized Block Design with sixteen treatments and three replications. Per plot 10 plants planted in each replication (1.35×0.90 m²). The experiment was conducted by using seven wild chilli rootstocks (CRS-1, CRS-2, CRS-3, CRS-4, CRS-5, CRS-6, CRS-7) and two hybrid scion cultivar of capsicum (Indra and Nimalite). The seeds of both rootstocks as well as scion were sown in protrays containing sterilized cocopeat to avoid the problem of uneven germination. The seeds of rootstock were sown 4 weeks before the scion seeds. The rootstock is essential to the scion in terms of growth and development, flowering and fruiting and fruit set and

improved resistance to diseases (Yun *et al.*, 2023). The wild rootstocks of chilli took 25–30 days for germination than other rootstocks (Rinku *et al.*, 2020).

The splice method of grafting was carried out when scion and rootstock seedling attained their respective height and girth, 1.6 mm silicon grafting clips were used for grafting. Grafted plants were placed in the healing chamber to ensure high grafting success. They were kept in healing chambers with a relative humidity 85–90% and 28–32°C temperature for 10 to 12 days to allow graft union. The pro trays were irrigated daily for 25 days. The grafted seedlings were transplanted in the main plot 20 days after grafting, when the grafts were at 3–4 true leaf stage (Zhen *et al.*, 2022). Grafted plants were planted to find its effect on growth and yield. The observations were recorded for rootstock, scion and grafts combination with respect to graft success, incidence of fusarium wilt, damping off, leaf curl virus, mosaic, thrips, root knot nematode crop duration related parameters, on wild chilli rootstock (Samanta *et al.*, 2017). The results were statistically analyzed on the basis of method of Panse and Sukhatme (1985).

Results and Discussion

The data recorded on rootstock and scion parameters, grafted plant parameters and percentage of diseases and pest presented in Table 1.

Percent disease and pest incidence

Fusarium wilt

The different rootstock showed significant differences for incidence of fusarium wilt. No incidence of fusarium wilt was recorded in rootstocks CRS-1, CRS-2 and CRS-5 rootstock, whereas the highest incidence (13.33%) of fusarium wilt recorded in CRS-4 rootstock. There were no significant differences between the scions in incidence of fusarium wilt. In rootstock interaction maximum incidence of fusarium wilt was observed in T3: Indra grafted on CRS-3 and T₁₁: Nimalite grafted on CRS-4 (13.33%). However, incidence of fusarium wilt was found non-significant among different graft combinations. The incidence of fusarium wilt was not observed in T₁ (Indra grafted on CRS-1), T₂ (Indra grafted on CRS-2), T₅ (Indra grafted on CRS-5), T₈ (Nimalite grafted on CRS-1), T₁₂ (Nimalite grafted on CRS-5). ero to lowest incidence of fusarium wilt were observed in grafted plants as compared to non-grafted plants. Grafting effect may contribute resistant reaction against fusarium wilt, in which rootstock play major role in reduction of incidence of fusarium wilt (Gebologlu *et al.*, 2011 and Srivastava *et al.*, 2018).

Table 1 : Effect of rootstocks on capsicum regarding percent fusarium wilt, damping-off, chilli leaf curl, chilli mosaic, chilli thrips and root knot nematode incidence.

Treatment details	Fusarium wilt (%)	Damping off (%)	Chilli leaf curl (%)	Chilli mosaic (%)	Chilli thrips (%)	Root knot nematode (%)
Factor 1: Rootstock effect						
CRS-1	0.00(0.00)	3.67(11.04)	12.83(20.99)	13.17(21.28)	17.33(24.60)	0.00(0.00)
CRS-2	0.00(0.00)	4.00(11.54)	25.83(30.55)	20.67(27.04)	23.67(29.11)	5.00(12.92)
CRS-3	8.33(16.78)	4.50(12.25)	21.00(27.27)	24.17(29.45)	24.33(29.56)	1.67(7.42)
CRS-4	13.33(21.42)	4.50(12.25)	17.67(24.85)	15.67(23.32)	21.33(27.51)	3.33(10.52)
CRS-5	0.00(0.00)	3.17(10.25)	19.33(26.08)	19.50(26.21)	22.33(28.20)	8.33(16.78)
CRS-6	10.00(18.43)	3.50(10.78)	16.83(24.22)	20.17(26.68)	19.33(26.08)	1.67(7.42)
CRS-7	6.67(14.96)	4.17(11.78)	18.67(25.60)	12.33(20.56)	16.17(23.71)	0.00(0.00)
SEm±	2.54	0.40	1.90	1.61	1.30	1.76
CD at 5 %	7.33	1.2	5.49	4.66	3.75	5.10
Factor 2: Scion effect						
Indra	5.42(13.46)	3.83(11.29)	21.50(27.62)	21.08(27.33)	22.21(28.11)	10.00(18.43)
Nemalite	5.42(13.46)	4.25(11.90)	18.04(25.13)	16.79(24.18)	19.68(26.33)	6.67(14.96)
SEm±	1.27	0.20	0.95	0.80	0.65	0.88
CD at 5 %	NS	0.60	2.74	2.33	1.87	NS
Interaction effect						
T ₁ : Indra grafted on CRS-1	0.00(0.00)	3.33	14.67(22.52)	12.33(20.56)	21.67(27.74)	0.00(0.00)
T ₂ : Indra grafted on CRS-2	0.00(0.00)	3.33(10.52)	22.33(28.20)	21.00(27.27)	20.33(26.80)	3.33(10.52)
T ₃ : Indra grafted on CRS-3	13.33(21.42)	4.67(12.48)	21.33(27.51)	16.00(23.58)	22.67(28.43)	0.00(0.09)
T ₄ : Indra grafted on CRS-4	10.00(18.43)	4.33(12.01)	22.33(28.20)	28.00(31.95)	26.67(31.09)	3.33(10.52)
T ₅ : Indra grafted on CRS-5	0.00(0.00)	2.67(9.40)	25.67(30.44)	19.33(26.08)	24.33(29.56)	6.67(14.96)
T ₆ : Indra grafted on CRS-6	10.00(18.43)	3.67(11.04)	22.00(27.97)	26.33(30.87)	23.33(28.88)	3.33(10.52)
T ₇ : Indra grafted on CRS-7	6.67(14.96)	4.00(11.54)	16.33(23.84)	14.67(22.52)	16.00(23.58)	0.00(0.00)
T ₈ : Nemalite grafted on CRS-1	0.00(0.00)	4.00(11.54)	11.00(19.37)	14.00(21.97)	13.00(21.13)	0.00(0.00)
T ₉ : Nemalite grafted on CRS-2	0.00(0.00)	4.67(12.48)	29.33(32.79)	20.33(26.80)	27.00(31.31)	6.67(14.96)
T ₁₀ : Nemalite grafted on CRS-3	6.67(14.96)	4.67(12.48)	20.00(26.57)	20.33(26.80)	22.00(27.97)	0.00(0.00)
T ₁₁ : Nemalite grafted on CRS-4	13.33(21.42)	4.33(12.01)	14.00(21.97)	15.33(23.05)	20.00(26.57)	6.67(14.96)
T ₁₂ : Nemalite grafted on CRS-5	0.00(0.00)	3.67(11.04)	22.33(28.20)	19.67(26.33)	20.33(26.80)	10.00(18.43)
T ₁₃ : Nemalite grafted on CRS-6	10.00(18.43)	3.33(10.52)	11.33(19.67)	14.00(21.97)	15.33(23.05)	0.00(0.00)
T ₁₄ : Nemalite grafted on CRS-7	6.67(14.96)	4.33(12.01)	11.67(19.97)	10.00(18.43)	16.33(23.84)	0.00(0.00)
T ₁₅ : Control (Indra)	3.33(10.51)	4.67(12.48)	27.33(31.52)	31.00(33.83)	22.67(28.43)	10(18.43)
T ₁₆ : Control (Nemalite)	6.67(14.96)	5.00(12.92)	24.67(29.78)	20.67(27.04)	21.00(27.27)	6.67(14.96)
SEm±	3.59	0.57	2.68	2.28	1.83	2.5
CD at 5 %	NS	1.68	7.76	6.59	5.31	NS



T₁ : Indra grafted on CRS-1



T₂ : Indra grafted on CRS-2



T₃ : Indra grafted on CRS-3



T₄ : Indra grafted on CRS-4



T₅ : Indra grafted on CRS-5



T₆ : Indra grafted on CRS-6



T₇ : Indra grafted on CRS-7



T₈ : Indra grafted on CRS-1

Plate 1 : Performance of treatments with different Chilli Rootstocks.

Fig. 1 continued...

Fig. 1 continued...

T₉: Nemalite grafted on CRS-2T₁₀: Nemalite grafted on CRS-3T₁₁: Nemalite grafted on CRS-4T₁₂: Nemalite grafted on CRS-5T₁₃: Nemalite grafted on CRS-6T₁₄: Nemalite grafted on CRS-7T₁₅: Indra (Control)T₁₆: Nemalite (Control)

Damping off

The lowest incidence of damping off (3.17%) recorded in CRS-5 rootstock which was found at par

with CRS-6 (3.50%) and CRS-1 rootstock (3.67%) rootstock, whereas the highest incidence of damping off was found in CRS-4 rootstock (4.50%). Significantly in



T₁: Indra grafted on CRS-1



T₂: Indra grafted on CRS-2



T₃: Indra grafted on CRS-3



T₄: Indra grafted on CRS-4



T₅: Indra grafted on CRS-5



T₆: Indra grafted on CRS-6



T₇: Indra grafted on CRS-7



T₈: Indra grafted on CRS-1

Plate 2 : Capsicum fruits of various treatments.

Plate 2 continued...

Plate 2 continued...



T₉: Indra grafted on CRS-2



T₁₀: Indra grafted on CRS-3



T₁₁: Indra grafted on CRS-4



T₁₂: Indra grafted on CRS-5



T₁₃: Indra grafted on CRS-6



T₁₄: Indra grafted on CRS-7



T₁₅: Indra (Control)



T₁₆: Nemalite (Control)

scion effect lower incidence of damping off was observed in scion Indra (3.83%) than that of Nemalite (4.25%). In interaction effect the lowest incidence of damping off

(2.67%) recorded in T₅ (Indra grafted on CRS-5), whereas highest incidence of damping off (5.00%) recorded in T₁₆ (Non grafted Nemalite). In capsicum



Plate 3 : Procedure of Splice Grafting.

graft combination which mainly reduce the incidence of pre and post emergence damping off which leads to increase in production with minimum losses (Kumar *et al.*, 2020 and Saba *et al.*, 2022).

Chilli leaf curl

The different rootstocks showed significant differences for incidence of chilli leaf curl. The lowest incidence (12.83%) was recorded in CRS-1 rootstock,

whereas highest incidence of chilli leaf curl (25.83%) was recorded in CRS-2 rootstock. Significantly in scion effect lower incidence of chilli leaf curl was observed in scion Nemalite (18.04%) than that of Indra (21.50%). The effect of graft combinations showed significant variations in per cent disease incidence of chilli leaf curl. The lowest incidence of chilli leaf curl (11.00%) recorded in T₈ (Nemalite grafted on CRS-1), whereas highest incidence of chilli leaf curl (29.33%) recorded in T₉ (Nemalite grafted on CRS-2). Grafted capsicum plants which develops leaf curl resistance mechanism which is caused by white fly (Olawale *et al.*, 2019; Vijeth *et al.*, 2020 and Suwor *et al.*, 2020).

Chilli mosaic

The different rootstocks showed significant differences for incidence of chilli mosaic. The lowest incidence of chilli mosaic (12.33%) reported in CRS-7 rootstock, whereas highest incidence of chilli mosaic (24.17%) observed in CRS-3 rootstock. In scion effect Nemalite (16.79%) recorded significantly lower incidence of chilli mosaic than that of Indra (21.08%). In interaction effect the lowest incidence of chilli mosaic (10.00 %) recorded in T₁₄ (Nemalite grafted on CRS-7%). Whereas, highest incidence of chilli mosaic (31.00%) recorded in T₁₅ (Non grafted Indra). Severity of the the chilli mosaic incidence which were reduced through resistance of rootstock by producing some allelopathic effect on mosaic as well as graft combinations which may developed resistance reaction to chilli mosaic (Devi *et al.*, 2020 and Herbaud *et al.*, 2022).

Chilli thrips

In various rootstocks the lowest incidence of chilli thrips (16.17%) reported in CRS-7 rootstock which was at par with rootstock CRS-1(17.33%) and CRS-6 (19.33%). Whereas, highest incidence of chilli mosaic (24.33%) observed in CRS-3 rootstock. Significantly in scion effect lower incidence of chilli thrips was observed in scion Nemalite (19.68%) than that of Indra (22.21%). In graft combination the lowest incidence of chilli thrips (13.00%) recorded in T₈ (Nemalite grafted on CRS-1), whereas highest incidence of chilli thrips (27.00%) recorded in T₉ (Nemalite grafted on CRS-2). Due to wider adaptability of graft combination to various environmental condition which play vital role in developing thrips resistant mechanism in grafted capsicum plants as compared to auto-grafted plants (Reddy *et al.*, 2017 and Gopal *et al.*, 2019).

Root knot nematode

In different rootstock effect no incidence of root knot

nematode was recorded in CRS-1 and CRS-7. It was found at par with rootstock CRS-3 (1.67%), CRS-6(1.67%) and CRS-4(3.33%), whereas highest incidence of root knot nematode (8.33%) observed in CRS-5 rootstock. Percent incidence of root knot nematode was found non-significant in scion effect. Interaction effect of graft combinations for percent incidence of root knot nematode was found non-significant. No incidence of root knot nematode was found in T₁ (Indra grafted on CRS-1), T₃ (Indra grafted on CRS-3), T₇ (Indra grafted on CRS-7), T₈ (Nemalite grafted on CRS-1), T₁₀ (Nemalite grafted on CRS-3), T₁₃ (Nemalite grafted on CRS-6), T₁₄ (Nemalite grafted on CRS-7). Good graft compatibility which significantly minimize incidence of root knot nematode and roots of grafted plants which able to release some allelo-chemicals which reduced the growth and multiplication of root knot nematode (Gebologlu *et al.*, 2011).

Conclusion

Thus from the present investigation it can revealed that the Nemalite grafted on CRS-7 reported minimum percent disease incidence of fusarium wilt, damping off, leaf curl, mosaic, thrips and no incidence of root knot nematode, respectively. There were no significant variations among graft combinations in incidence of fusarium wilt and root knot nematode. Nemalite grafted on CRS-7 recorded minimum incidence of fusarium wilt (6.67%), damping off (4.33%), leaf curl (11.67%), chilli mosaic (10.00%), thrips (16.33%) and root knot nematode (0.00%). Hence, the Nemalite grafted on CRS-7 rootstock superior for better growth and yield and also for highest B:C ratio.

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