

Effect of Foliar Spray of Plant Growth Regulators and Optimum Planting Ratio on Seed Quality in CGMS Based Chilli Hybrid UARChH42 (JCH 42)

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ABSTRACT: In the present investigation the seed production in newly released chilli hybrid was carried out while studying the effect of planting ratio (2:1 was best) and PGR spray (NAA @ 40 ppm best) on seed quality parameters viz., germination (%), seedling dry weight (mg) shoot length (cm), seedling vigour index, dehydrogenase enzyme activity and lower electrical conductivity (dS cm⁻¹) as compared to other treatments. Also the treatment combination P₂S₄ (2:1 + NAA @40 ppm) proved to be the best. This treatment combination resulted in higher values of these parameters as well. Thus the parental lines in 2:1 ratio proved to be best for natural crossing followed by spraying at flower initiation stage with NAA @ 40 ppm as PGR to obtain higher seed quality in CMS based chilli hybrid UARChH42 (JCH42).

Keywords: Chilli, CMS based hybrid, Plant growth regulators, Planting ratio

Chilli (*Capsicum annum* L.) is an important spice as well as vegetable in world fetching higher price as a commercial crop. The Greek word 'Kapsimo' which means 'to bite' hence the name *Capsicumis* derived from it. Mexico is the primary center of origin in which five major cultivated species of chilli originated. This member of nightshade family Solanaceae is called as *Mirch* in Hindi, *Mensinkaayi* in Kannada. It was carried by portugese from Brazil to India in 1885 [1]. It is cultivated on an area of 364 thousand hectares in India with a production of 3720 thousand metric tonnes 2018-19 [2]. Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu accounts for three-fourth of the total area under chilli cultivation.

A good quality seed is the backbone of a good crop production. Production of varietal seed or hybrid seed always requires tremendous efforts from breeding, production and harvesting of seed. In chilli the most popular technique of hybrid seed production is by emasculation and pollination. A genetically pure and good quality seeds is produced by adopting suitable seed production techniques. In present research cytoplasmic male sterility is employed to produce hybrid seed that can also reduce the cost of skilled labourers needed for

emasculation and pollination thus further reduces hybrid seed cost by about 50 per cent [3]. For the implementation of CGMS the male and female parent are sown ratio in the field and allowed to set fruits naturally. Afterwards hybrid fruits are harvested from female parent. [4] Standardized 2 : 1 as best planting ratio for hybrid seed production of chilli hybrid 'CH-3'. Plant growth can be stimulated during crop production by use of certain chemicals that can affect it e.g. PGR or plant growth regulators. These are considered as new generation agrochemicals after fertilizers, pesticides and herbicides e.g. GA₃ and NAA, Cytokinins. PGRs are also important to modify the growth, sex ratios and yield contributing characters of plant [5]. The present investigation was carried out to produce hybrid seeds of chilli hybrid using PGR in amalgamation with CGMS.

MATERIAL AND METHODS

The experiment was carried out in College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka during *kharif* 2016 and 2017. The seeds of A line and R line were first sown separately in pro trays inside nursery under shade net in June 2016 and 2017 and 45 days old well developed seedlings were transplanted in the main

field in August 2016 and 2017, respectively at spacing of (90 × 60 cm) row to row and plant to plant and each in different ratios *viz.*, 1:1, 2:1, 3:1 and 3:2. As already discussed in the introduction the importance of planting ratios in getting higher fruit set. Also the chemicals regulating plant growth serves to ameliorate the physiological characteristics of plant. Hence the treatments were decided as foliar sprays of different plant growth regulators (PGR) treatments *viz.*, control (no chemical spray), 2, 4-D @ 2 ppm, GA₃ @ 50 ppm and NAA @ 40 ppm were done on the crop at initial stages of flowering, then at 30 days interval. Factorial experimental design with 16 treatment combinations (4 planting ratios × 4 PGR sprays) was laid out in Factorial Randomized Complete Block Design (FRCBD) in field and Factorial Completely Randomized Design (FCRD) in laboratory. For each treatment seed quality parameters were recorded *viz.*, germination (%) [6], shoot length (cm), root length (cm), seedling dry weight (mg) and seedling vigour index [7]. Seed biochemical parameters were recorded *viz.*, electrical conductivity (dS cm⁻¹), α-amylase enzyme activity (diameter of halos) and dehydrogenase enzyme activity (OD value) [8]. The statistical analysis was carried out for each observed character under the study using MS-Excel. The mean values of data for FRCBD and CRD were subjected to analysis of variance as per the design of experiment as suggested by Gomez [9].

RESULTS AND DISCUSSION

The analysis of variance results revealed that planting of the parent lines in P₂ (2:1) planting ratio resulted in maximum seed quality parameters. This might be attributed due to higher reserve food found in the seeds of these treatments which helped them to show higher physiological quality. In 2:1 planting ratio the amount of pollen grains available are ample for proper seed set, formation and development (Table 1) thus increased germination (80.67 and 83.92 %), shoot length (8. and 10.00 cm), seedling dry weight (2.74 and 3.17 mg), seedling vigour index (1606 and 1951), lower electrical conductivity (0.098 and 0.097 dScm⁻¹) and higher dehydrogenase enzyme activity (0.189 and 0.198) and α-amylase enzyme activity (12.21 and 13.00) were recorded in this ratio in the year 2016 and 2017 respectively. Whereas, planting ratio P₄ (3: 2) recorded lowest values of seed quality characters which may be due to deposition of inadequate viable pollens on the stigma of A line found in this ratio. Lower seed set render physiologically and biochemically unfit seeds as a

consequence of under developed embryo. These might have reduced the fruit set as well as seed production. Similar results were obtained by [10] in tomato who reported increased seed quality parameters in 3:1, 4:1 and 5:1 ratio attributed due to higher reserve found in the seeds of these treatments and also by [11] in brinjal and [12] in okra. The significant variation in electrical conductivity may be due to the anatomical structure, membrane permeability and composition of seed coat which reduced the EC value under this treatment because of more intact and sound seed coat cell membrane.

In case of effect of PGR the application of NAA @ 40 ppm ascribed to have provided the adequate supply of food reserves to resume embryo growth and synthesis of hydrolytic enzymes which are secreted and act on starchy endosperm, this in turn affects physiology of seed. It resulted in higher germination (78.00 and 81.08 %), shoot length (8.08 and 9.86 cm), seedling dry weight (2.67 and 3.03 mg) establishment of seedling and ultimately the seedling vigour index (1552 and 1872) in 2016 and 2017 respectively (Table 1). Similar results were obtained by [13] who reported 2.5–6.3% and 8.9–19.8% increase in germination percentage and vigour index respectively from GA₃ (30 g hm⁻²) application after anthesis in rice. Seed biochemical parameter *viz.*, higher dehydrogenase enzyme activity (0.203 and 0.212 OD value), and α-amylase enzyme activity (12.71 and 15.70) and lower electrical conductivity (0.096 and 0.093 dS cm⁻¹) in the year 2016 and 2017 respectively, was also observed in this treatment. Lowest values of seed quality parameters were observed in S₂ (2, 4-D @ 2 ppm spray) which did not affect the quality parameters very well. These outcomes are in conformity with the findings of [14] in bitter gourd seeds wherein NAA 50 ppm showed higher seed quality because food reserves are supplied adequately to resume embryo growth and synthesis of hydrolytic enzymes that alters the physiology of seed germination, establishment of seedling and ultimately the vigour index, also in pigeon pea by [15] and in okra by [16].

Also the interaction P₂S₄ (2:1 + NAA @ 40 ppm) of planting ratio and PGR spray showed higher values of seed quality and biochemical parameters. In general a planting ratio of 2:1 for parental lines followed by natural crossing and foliar spray of NAA @ 40 ppm as plant growth regulator can be recommended for obtaining higher seed quality parameters in chilli hybrid UARCH42 (JCH42)

Table 1. Effect of planting ratio and foliar spray of plant growth regulators on seed quality parameters in chilli hybrid UARChH42 (JCH42)

Treatment	Germination (%) [*]		Shoot length (cm)		Seedling dry weight (mg)		Seedling vigour index		EC (dS cm ⁻¹)		DAA (OD value)		AAEA (mm)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
P ₁	72.00 ^a (58.12)	74.67 ^a (59.89)	7.01 ^a	8.80 ^a	2.40	2.87	1199 ^a	1519	0.114 ^a	0.110 ^a	0.166	0.172	9.02	11.56 ^b
P ₂	80.67 (64.05)	83.92 (66.55)	8.13	10.00	2.74	3.17	1606	1951	0.098	0.097	0.189	0.198	12.21	13.00 ^a
P ₃	70.42 ^a (57.15)	73.58 ^a (59.23)	7.12 ^a	7.98 ^b	2.26 ^a	2.45 ^a	1191 ^a	1380 ^a	0.113 ^a	0.108 ^a	0.146	0.153	9.00	11.77 ^{ab}
P ₄	70.42 ^a (57.07)	73.25 ^a (58.89)	6.93 ^a	8.23 ^{ab}	2.18 ^a	2.46 ^a	1165 ^a	1399 ^a	0.122	0.117	0.131	0.136	7.11	8.15
S. Er _m ±	0.50	0.62	0.083	0.151	0.027	0.062	13.16	26.57	0.001	0.001	0.002	0.003	0.32	0.37
CD @ 1 %	1.92	2.39	0.320	0.584	0.106	0.240	50.98	102.88	0.004	0.003	0.010	0.010	1.25	1.43
S ₁	71.75 (57.94)	74.25 (59.58)	6.89 ^a	8.27 ^a	2.29	2.66 ^a	1129 ^a	1367 ^a	0.116	0.111	0.140	0.145	8.47	10.49 ^a
S ₂	67.75 (55.48)	70.42 (57.15)	6.81 ^a	7.83 ^a	2.13	2.40	1086 ^a	1299 ^a	0.130	0.124	0.117	0.119	5.85	6.07
S ₃	76.00 (60.80)	79.67 ^a (63.39)	7.40	9.05	2.49	2.85 ^a	1393	1712	0.106	0.104	0.172	0.181	10.30	12.22 ^a
S ₄	78.00 (62.16)	81.08 ^a (64.42)	8.08	9.86	2.67	3.03	1552	1872	0.096	0.093	0.203	0.212	12.71	15.70
S. Er _m ±	0.50	0.62	0.083	0.151	0.027	0.062	13.16	26.57	0.001	0.001	0.002	0.003	0.32	0.37
CD @ 5 %	1.92	2.39	0.320	0.584	0.106	0.240	50.98	102.88	0.004	0.003	0.010	0.010	1.25	2.87
P ₁ S ₁	70.33 ^{cd} (57.00)	71.33 ^d (57.63)	6.67 ^c	8.97 ^b	2.27	2.92	1023 ^c	1387 ^c	0.115 ^{cd}	0.110 ^c	0.147 ^d	0.152 ^{ef}	8.06	9.43
P ₁ S ₂	66.33 ^e (54.54)	69.00 ^d (56.18)	6.59 ^c	7.81 ^c	2.11	2.44	1016 ^{cd}	1256 ^d	0.136 ^{ef}	0.127 ^g	0.132 ^{ef}	0.136 ^f	5.45	6.78
P ₁ S ₃	74.33 ^b (59.57)	77.67 ^b (61.81)	7.12 ^b	8.92 ^b	2.47	2.90	1307 ^b	1646 ^{ab}	0.107 ^{bc}	0.106 ^b	0.179 ^{bc}	0.187 ^{cd}	9.31	12.69
P ₁ S ₄	77.00 ^b (61.35)	80.67 ^b (63.93)	7.66 ^{ab}	9.51 ^{ab}	2.74	3.23	1450 ^a	1789 ^a	0.100 ^{ab}	0.097 ^a	0.207 ^a	0.213 ^{ab}	13.25	17.32
P ₂ S ₁	77.67 ^b (61.81)	80.67 ^b (63.94)	7.57 ^b	8.80 ^b	2.63	2.92	1306 ^b	1503 ^{bc}	0.105 ^b	0.106 ^b	0.166 ^c	0.168 ^{de}	12.31	13.58
P ₂ S ₂	76.00 ^b (60.68)	79.00 ^b (62.73)	7.32 ^b	8.52 ^b	2.41	2.81	1290 ^b	1571 ^b	0.116 ^d	0.117 ^{ef}	0.130 ^e	0.134 ^{fg}	8.39	6.52
P ₂ S ₃	83.67 ^a (66.23)	87.33 ^a (69.19)	8.25 ^a	10.63 ^a	2.89	3.40	1763	2206	0.094 ^a	0.090	0.213 ^a	0.227 ^a	12.85 ^a	14.71
P ₂ S ₄	85.33 ^a (67.48)	88.67 ^a (70.33)	9.37	12.05	3.03	3.56	2063	2525	0.079	0.076	0.246	0.263	15.27 ^a	17.19
P ₃ S ₁	70.00 ^d (56.17)	73.00 ^c (58.70)	6.68 ^c	7.51 ^{cd}	2.21	2.44	1093 ^c	1261 ^d	0.117 ^d	0.108 ^c	0.131 ^e	0.136 ^f	7.50	11.71
P ₃ S ₂	61.33 (51.55)	63.67 (52.95)	6.62 ^c	6.80 ^d	2.03	2.14	963 ^d	1043	0.126 ^e	0.117 ^e	0.108 ^{gh}	0.108 ^{hi}	4.09	7.20
P ₃ S ₃	74.00 ^{bc} (59.35)	79.00 ^b (62.76)	7.19 ^b	8.42 ^{bc}	2.34	2.56	1294 ^b	1569 ^b	0.107 ^{bc}	0.107 ^{bc}	0.149 ^d	0.163 ^e	11.14	12.23
P ₃ S ₄	76.33 ^b (60.90)	78.67 ^b (62.51)	7.99 ^a	9.17 ^b	2.46	2.65	1414 ^a	1647 ^a	0.100 ^{ab}	0.101 ^{ab}	0.196 ^{ab}	0.202 ^{bc}	13.28 ^a	15.94
P ₄ S ₁	69.00 ^d (56.17)	72.00 ^{cd} (58.07)	6.65 ^c	7.81 ^c	2.05	2.37	1094 ^c	1315 ^{cd}	0.127 ^e	0.121 ^{fg}	0.116 ^g	0.125 ^{gh}	6.02	7.22
P ₄ S ₂	67.33 ^{de} (55.15)	70.00 ^d (56.80)	6.71 ^c	8.17 ^c	1.99	2.23	1073 ^c	1324 ^c	0.143 ^f	0.135	0.096 ^h	0.099 ⁱ	5.45	3.76
P ₄ S ₃	72.00 ^c (58.05)	74.67 ^c (59.80)	7.03 ^{bc}	8.23 ^c	2.25	2.56	1209 ^b	1428 ^c	0.114 ^{cd}	0.112 ^{ce}	0.146 ^{de}	0.147 ^f	7.91	9.26
P ₄ S ₄	73.33 ^c (58.92)	76.33 ^{bc} (60.90)	7.31 ^b	8.73 ^b	2.43	2.68	1282 ^b	1529 ^b	0.106 ^b	0.100 ^a	0.164 ^{cd}	0.171 ^d	9.04	12.35
Mean	73.38	76.35	7.30	8.75	2.39	2.74	1290	1562	0.112	0.108	0.158	0.164	9.333	11.119
S. Er _m ±	0.99	1.23	0.165	0.302	0.055	0.124	26.33	53.13	0.002	0.002	0.005	0.005	0.64	0.74
CD @ 1 %	3.85	4.78	0.641	1.168	NS	NS	101.97	205.77	0.007	0.006	0.019	0.020	2.49	NS

Values followed by same alphabets are on par with one another

Treatment details are given in legend; *Figures in parenthesis represent arcsine transformation, EC = Electrical Conductivity, DAA = Dehydrogenase enzyme activity, AAEA = Alpha amylase enzyme activity (Diameter in mm)

LEGEND: P₁ = 1:1; P₂ = 2:1; P₃ = 3:1; P₄ = 3:2; S₁ = no chemical spray; S₂ = 2, 4-D @ 2 ppm; S₃ = GA₃ @ 50 ppm; S₄ = NAA @ 40 ppm; P₁S₁ = (1:1 + no chemical spray); P₁S₂ = (1:1 + 2, 4-D @ 2 ppm); P₁S₃ = (1:1 + GA₃ @ 50 ppm); P₁S₄ = (1:1 + NAA @ 40 ppm); P₂S₁ = (2:1 + no chemical spray); P₂S₂ = (2:1 + 2, 4-D @ 2 ppm); P₂S₃ = (2:1 + GA₃ @ 50 ppm); P₂S₄ = (2:1 + NAA @ 40 ppm); P₃S₁ = (3:1 + no chemical spray); P₃S₂ = (3:1 + 2, 4-D @ 2 ppm); P₃S₃ = (3:1 + GA₃ @ 50 ppm); P₃S₄ = (3:1 + NAA @ 40 ppm); P₄S₁ = (3:2 + no chemical spray); P₄S₂ = (3:2 + 2, 4-D @ 2 ppm); P₄S₃ = (3:2 + GA₃ @ 50 ppm); P₄S₄ = (3:2 + NAA @ 40 ppm)

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