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Short communication

Effect of planting ratio (Female: Male) and foliar spray of plant growth regulators on seed yield in CMS based chilli hybrid UARChH42 (JCH42)

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ABSTRACT

Present experiment was aimed to determine the effect of planting ratio followed by PGR spray on seed yield of newly released chilli hybrid UARChH42 (JCH42). Significantly higher value of number of fruits plant^{-1} (37.86 and 44.01), seed yield (27.68 and 27.75 kg ha^{-1}) and number of seeds per fruit (72.68 and 74.30) was obtained in P_2 (2:1) planting ratio and PGR spray of S_4 (NAA @ 40 ppm) respectively. Similar trend was seen in treatment combination P_2S_4 (2:1 + NAA @ 40 ppm). Results revealed that 2:1 ratio proved to be best for natural crossing followed by spraying at flower initiation stage with NAA @ 40 ppm to obtain higher seed yield.

Key words: *Capsicum annuum*, plant growth regulators, planting ratio.

Chilli (*Capsicum annuum* L.) is a member of solanaceae family and one of the most valuable fruit vegetables in the world. *Capsicum* is derived from the Greek word 'Kapsimo' meaning 'to bite'. In India, chilli occupies an area of 364 thousand hectares with a production of 3720 thousand metric tonnes and productivity of 10.2 metric tonnes per hectare in (Anonymous, 1). The popularity of chilli F_1 hybrid seed production through cultivars developed by cytoplasmic male sterility (CMS) eliminating emasculation is increasing worldwide. Therefore, it is necessary to produce genetically pure and good quality seeds by adopting suitable seed production techniques. Using CMS to produce hybrids may reduces the hybrid seed cost by about 50 per cent (Aulakh, 2) and ensures purity of the F_1 seed as there is no chance of selfing. CMS utilizes female and male plants which are sown in a definite ratio in field and allowed to set fruits naturally and hybrid fruits are harvested from female parent. Khurana *et al*. (4) standardized 2 : 1 as best planting ratio for hybrid seed production of chilli hybrid 'CH-3'. For enhancing the yield in these lines plant growth regulators (PGR's) proves beneficial to stimulate and modify natural growth regulatory system. They are considered as new generation agrochemicals after fertilizers, pesticides and herbicides. GA_3 and NAA are also important growth regulators that may have ability to modify the growth, sex ratios and yield contributing characters of plant. The purpose of present investigation was to study the combined as well as individual effect of various planting ratios and PGR spray on chilli seed yield.

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The experiment was carried out during *kharif* 2016 and 2017 at University of Agricultural Sciences, Raichur, Karnataka. Seeds of A line and R line were sown separately in pro trays inside nursery under shade net and were transplanted in the main field after 45 days 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. The foliar sprays of different PGR treatments *viz*., control (no chemical spray), 2, 4-D @ 2 ppm, GA_3 @ 50 ppm and NAA @ 40 ppm were done on the crop at initial stages of flowering and then at 30 days interval. Factorial experimental design with 16 treatment combinations (4 planting ratios × 4 PGR sprays) was laid out in Randomized Complete Block Design (FRCBD) in field and Factorial Completely Randomized Design (FCRD) in laboratory. For each treatment yield parameters were recorded (Table 1). Seed yield (kg ha^{-1}) was calculated using following formula. The statistical analysis was carried out for each observed character under the study using MS-Excel, OPSTAT software & ANOVA as per the design of experiment

$$\text{Seed yield (kg ha}^{-1}) = \frac{\text{Seed yield per sq m (g)} \times 10000}{1000}$$

OPSTAT software available on the CCSHAU home page
ANOVA - Analysis of Variance

The analysis of variance results revealed that planting of the parent lines in (2:1) P_2 ratio resulted in maximum yield (Table 1) *viz*. dry fruit yield per plant (52.84 and 54.69 g), number of fruits per plant (42.57 and 44.01), seed weight per fruit (0.402 and 0.419 g), seed yield (27.06 and 27.75 kg ha^{-1}) in the year 2016 and 2017 respectively. Also, higher number of seeds per fruit (74.87 in 2016, 78.26 in 2017) were recorded in (1: 1) P_1 ratio and it was on

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

Treatment	Dry fruit yield plant^{-1} (g)		Number of fruits plant $^{-1}$		Number of seeds per fruit		Seed weight per fruit (g)		Seed yield (kg ha^{-1})	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Main effect (Planting Ratio - P)										
P_1	40.60	44.28	31.67	33.13	74.87^{a}	78.26^{a}	0.386^{ab}	0.391^{a}	25.63	25.97
P_2	52.84	54.69	42.57	44.01	72.68^{a}	76.85^{a}	0.402^{a}	0.419	27.06	27.75
P_3	37.27^{a}	38.47^{a}	27.05 ^{a}	27.90 ^{a}	62.62	67.47	0.367^{b}	0.386^{a}	24.42	24.53
P_4	35.97^{a}	37.00 ^{a}	26.80 ^{a}	26.45 ^{a}	56.81	59.08	0.363^{b}	0.361	21.61	22.72
S. Em±	1.03	0.63	0.73	0.55	1.33	0.84	0.008	0.007	0.30	0.23
Main effect (PGR Spray- S)										
CD @ 5 %	2.97	1.82	2.10	1.58	3.83	2.42	0.024	0.020	0.86	0.67
S_1	40.73^{a}	42.70 ^{a}	31.29 ^{a}	32.07 ^{a}	65.33^{b}	67.88	0.377	0.393^{a}	24.86^{a}	24.92
S_2	37.41	39.69	27.79	28.70	58.96	64.46	0.364	0.370	21.35	22.71
S_3	41.22 ^{a}	43.69 ^{a}	32.51 ^{a}	32.86 ^{a}	67.79^{ab}	71.43	0.382	0.389^{a}	25.23^{a}	25.67
S_4	47.31	48.36	36.50	37.86	69.88^{a}	74.30	0.395	0.405^{a}	27.28	27.68
S. Em±	1.03	0.63	0.73	0.55	1.33	0.84	0.008	0.007	0.30	0.23
CD @ 5%	2.97	1.82	2.10	1.58	3.83	2.42	NS	0.020	0.86	0.67
Interaction effect (PXS)										
P_1S_1	40.11	44.13^{bc}	31.07^{cd}	33.02^{de}	61.57^{d}	70.24^{cd}	0.386	0.382	25.99^{ab}	25.37^{b}
P_1S_2	38.29	40.55^{cd}	28.77^{d}	29.93^{ef}	55.69^{e}	65.69^{de}	0.358	0.378	23.32^{cd}	24.08^{b}
P_1S_3	39.08	45.56^{b}	32.07^{bc}	34.44^{d}	75.47^{ab}	78.35^{a}	0.387	0.389	26.49^{a}	27.11^{a}
P_1S_4	44.93	46.88^{b}	34.77^{b}	35.14^{cd}	77.9^{a}	81.47^{a}	0.411	0.415	26.73^{a}	27.32^{a}
P_2S_1	48.01	50.39^{a}	38.89 ^{a}	40.05 ^{ab}	76.52^{a}	79.52^{a}	0.397	0.418	27.22^{a}	27.89^{a}
P_2S_2	46.63	47.30 ^{ab}	36.11 ^{ab}	37.56^{bc}	70.04^{bc}	73.70^{bc}	0.389	0.402	22.26^{d}	22.99^{c}
P_2S_3	52.63	54.75	43.49	42.22^{a}	76.11^{a}	78.33^{ab}	0.409	0.419	27.55^{a}	27.63^{a}
P_2S_4	64.11	66.31	51.79	56.23	76.80^{a}	78.84^{a}	0.414	0.439	31.20	32.49
P_3S_1	37.23	38.53^{d}	27.44^{de}	27.85^{f}	65.95^{c}	64.15^{e}	0.367	0.406	24.76^{b}	24.05^{bc}
P_3S_2	32.84	35.36^{e}	22.34^{f}	23.44^{h}	58.36^{d}	62.69^{ef}	0.351	0.373	21.08^{e}	21.89^{d}
P_3S_3	36.37	36.96^{e}	26.72^{e}	28.65^{f}	62.01^{d}	70.47^{c}	0.370	0.379	24.98^{b}	25.11^{b}
P_3S_4	42.63	43.03^{c}	31.70^{c}	31.67^{e}	64.17^{cd}	72.58^{c}	0.381	0.387	26.85^{a}	27.08^{a}
P_4S_1	37.59	37.75^{d}	27.78^{d}	27.38^{fg}	57.27^{de}	57.61^{f}	0.359	0.367	21.46^{e}	22.35^{d}
P_4S_2	31.90	35.55^{e}	23.93^{ef}	23.88^{h}	51.78^{e}	55.78^{f}	0.358	0.326	18.74	21.86^{d}
P_4S_3	36.81	37.50^{d}	27.76^{d}	26.15^{gh}	57.55^{d}	58.60^{f}	0.362	0.368	21.89^{de}	22.83^{cd}
P_4S_4	37.58	37.21^{de}	27.73^{d}	28.39^{f}	60.65^{d}	64.32^{e}	0.374	0.381	24.33^{bc}	23.83^{c}
Mean	41.67	43.61	32.02	32.87	65.49	69.52	0.380	0.389	24.68	25.24
S. Em±	2.06	1.26	1.45	1.10	2.65	1.68	0.016	0.014	0.59	0.46
CD @ 5 %	NS	3.65	4.19	3.17	7.66	4.85	NS	NS	1.72	1.34

Values followed by same alphabets are on par with one another; Treatment details are given in legend

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)

par with P_2. Further, alteration in the ratio resulted in a reduction in these parameters as minimum yield parameters were observed in the planting ratio P_4 (3: 2). In P_2 the male parent was sufficient to provide maximum pollen availability for fertilization of sterile population of female parent and the plant population of female line in this ratio was sufficient enough to produce optimum amount of fruit and seed yield and increase the yield parameter as compared to other ratios. In P_1 (1: 1) planting ratio due to availability of higher pollens per female flower, an increase in the number of seeds per fruit was observed and that was on par with the planting ratio P_2 (2: 1). Whereas, in 3:2 ratio, due to insufficient amount of pollens might not have completely fertilized all the ovules thus it lead to lower fruit and seed yield. These results are in conformity with the findings of Khurana *et al.,* (4) and Kumari *et al.* (6) in chilli, Kumar *et al.* (5) in tomato. In case of effect of PGR the application of NAA @ 40 ppm ascribed to more efficient utilization of food for reproductive growth (flowering and fruit set), higher photosynthetic efficiency and enhanced source to sink relationship of the plant, accumulation of sugar and other metabolites that further contributed for the higher dry fruit yield plant^{-1} (47.31 and 48.36 g), number of fruits plant^{-1} (36.50 and 37.86), number of seeds per fruit (69.88 and 74.30), seed weight per fruit (0.405 g in 2017) and seed yield (27.28 and 27.68 kg ha^{-1}) in the year 2016 and 2017 respectively (Table 1). Also lowest values of these parameters were observed in the spray S_2 (2, 4-D @ 2 ppm) which suggests that this chemical was not able to fulfill the nutritional requirement of plant as compared to NAA. Similar results were observed by Tamilselvi and Vijayaraghavan (9), Singh *et al.* (8), Patel *et al.* (7) and Gare *et al.* (3) in chilli. Spraying of NAA might 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 affected physiology of seed and further improved the growth and yield. Planting ratio of 2:1 for parental lines followed by natural crossing and foliar spray of NAA @ 40 ppm as plant growth regulator was effective for obtaining higher fruit yield and seed yield in chilli hybrid UARChH42 (JCH42).

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