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Growth and yield of AGCr-1 coriander affected by plant geometry and nutrition

G Lal[1,*,†], M K Choudhary[1], S S Meena[1] & N Kumar[2]
[1]*ICAR-NRC on Seed Spices, Tabiji, Ajmer-305206, Rajasthan.*
[2]*Dayanand College, Ajmer-305001, Rajasthan.*
[*]*Email: glal67@yahoo.co.in*

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Abstract

A study was conducted during Rabi season of 2015-16 and 2016-17 at the Research Farm of ICAR-NRC on Seed Spices, Ajmer, Rajasthan to assess the influence of plant geometry and different levels of nutrition on vegetative growth and yield of coriander variety Ajmer Green Coriander-1 (AGCr-1). The treatments comprised of three crop geometry (25 cm x 5 cm, 25 cm x 7.5 cm and 25 cm x 10 cm) and three levels of NPK (40:25:20 kg ha^{-1}, 50:35:25 kg ha^{-1} and 60:45:30 kg ha^{-1}) laid out in Randomized Factorial Block Design. The vegetative growth attributes *viz*., plant height at different growth stages, length of first leaf, length of second leaf, number of basal leaves $plant^{-1}$, primary branches $plant^{-1}$ and secondary branches $plant^{-1}$ recorded the highest level with the application of 60:45:30 kg ha^{-1} NPK combined with (25 cm x 7.5 cm) crop geometry. Similarly, yield parameters like number of umbel $plant^{-1}$, number of umbellates $umbel^{-1}$ and seed yield (1253.0 kg ha^{-1}) were also maximum with the same treatment.

Keywords: crop geometry, nutrient levels, vegetative growth, seed yield

Coriander is an important spice crop mostly grown for both green leaves and seeds. The efforts like nutrient management and crop breeding programs are important to get better seed yield due to its higher demand for use in confectionery, perfumery and medicine. Application of nutrients at optimal level and geometry of crop (row to row and plant to plant spacing) are the key factors to improve the seed yield of this important spice crop (Lal *et al*., 2020) The yield levels can be enhanced with the application of optimum nutritional doses and sowing of the crop at appropriate spacing. Since Ajmer Green Coriander-1 (AGCr-1) is a newly developed variety, it was felt that it is necessary to study the response of this variety to the application of different levels of major nutrients (Nitrogen, phosphorous and potassium) and different plant geometry for vegetative growth, yield attributing characters and seed yield. Coriander AGCr-1, a promising variety of coriander suitable for seed as well as green leaves. The current field experimentation was conducted with the objective to find out

[†]Current address: *Cauvery Water Management Authority, Ministry of Jal Shakti (GOI), New Delhi*

suitable nutrient doses and optimum plant geometry for good vegetative growth and yield.

The study was carried out at the Research Farm of ICAR-NRC on Seed Spices, Ajmer, Rajasthan during two consecutive winter seasons of the year 2015-16 and 2016-17. The research location was having sandy loam soil with pH 8.3. The research trial was laid out in Factorial Randomized Block Design (FRBD) with four replications. The treatments comprised of three doses of NPK 40:25:20, 50:35:25 and 60:45:30 kg ha^{-1} and three crop geometry *viz.,* 25 cm x 10 cm, 25 cm x 7.5 cm and 25 cm x 5.0 cm. In all, there were nine treatment combinations in the study. Sowing of AGCr-1 was carried out as per treatments using recommended seed rate and there were three spacing treatments (25 x 5 cm, 25 x 7.5 cm & 25 x 10 cm). A light irrigation was given just after sowing to ensure proper germination and establishment of the crop. Subsequent irrigations were given at an interval of 20-25 days on the basis of cumulative pan evaporation. NPK nutrients were supplied to the crop as per standard package of practices. Fifty per cent of nitrogen and 100% of phosphorus and potash were given to the crop as basal dose at the time of sowing and rest 50% of nitrogen was split into two equal parts and supplied to the crop as top dressing at 30 and 60 days after sowing (DAS). Random selection and tagging of 10 plants were done from each plot for recording the observation during the entire crop period up to harvesting and threshing. Data was recorded on seed germination, height of plant at different stages, leaf size, number of branches per plant, yield attributes (number of umbels $plant^{-1}$, number of umbellates $umbel^{-1}$) and yield $hectare^{-1}$. Statistical analysis of the data was performed as per the procedures laid out by Panse & Sukhatme (1985).

Influence of plant geometry on vegetative growth and seed yield

Results presented in Table 1 revealed that germination initiated in 7 to 8 days after sowing and was not influenced significantly by crop geometry treatments. Contrary to the above, the seed germination was influenced significantly by different treatments of crop geometry (11.13 days after sowing in G_1 treatment to 11.75 days after sowing in G_3 treatment). Though the difference was not considered so high and the germination of AGCr-1 seed was completed in 11 to 12 days. Findings of the present investigation related to different growth parameters, seed yield and yield attributes (Table 1 and 2) revealed that the maximum plant height at 30 DAS (9.73 cm) and maximum number of basal leaves $plant^{-1}$ (17.49) was recorded with G_2 (25 cm x 7.5 cm) treatment. Other plant growth parameters were not influenced significantly by different row and plant spacing treatments. However, plant height at 60 DAS (27.50 cm), at 90 DAS (109.79 cm) & at harvest (135.89 cm), first leaf length (29.03 cm), second leaf length (25.82 cm), number of primary branches (7.94) and number of secondary branches (30.22) were maximum with crop geometry 25 cm x 7.5 cm (G_2 treatment). Plant height was maximum under optimum plant geometry compared to other growth characters which might be due to relatively less competition for light among the plants. The reduced intensity of light at the base of the plant might have hastened elongation of poorer internodes leading to increased height of the plants. The recorded crop behaviour under closer spacing is in solid agreement with the results of Diwan *et al.* (2018) and Lal *et al.* (2020), where they reported that in various crops up to a certain level of population, plants grow fast due to self shading but beyond this, elongation is ceased due to reduced photosynthetic activity.

The findings (Table 2) of investigation further revealed that yield attributes like number of umbels $plant^{-1}$ and number of umbellates $umbel^{-1}$ were not influenced significantly, though seed yield of the coriander variety AGCr-1 was affected considerably with

Table 1. Effect of plant geometry and nutritional levels on seed germination, plant height, leaf length and number of basal leaves in coriander (Pooled 2015-16 and 2016-17).

Treatment	Days for initiation of germination	Days of complete germination	Plant height at 30 DAS (cm)	Plant height at 60 DAS (cm)	Plant height at 90 DAS (cm)	Plant height at harvest (cm)	1st leaf length (cm)	2nd leaf length (cm)	No. of basal leaves /plant
Plant Geometry									
G_1	7.54	11.13	8.38	26.45	106.08	133.93	28.17	24.96	16.19
G_2	7.50	11.54	9.73	27.50	109.79	135.89	29.03	25.82	17.49
G_3	7.67	11.75	9.34	27.28	108.74	134.76	28.52	25.31	16.77
SEm±	0.11	0.16	0.13	0.39	1.57	1.96	0.42	0.37	0.24
CD (p=0.05)	NS	0.47	0.38	NS	NS	NS	NS	NS	0.68
Fertilizer Levels									
F_1	7.54	11.67	8.74	26.51	107.14	134.31	28.21	25.00	15.67
F_2	7.50	11.25	9.00	26.97	107.27	134.47	28.32	25.10	16.12
F_3	7.67	11.50	9.72	27.75	110.20	135.80	29.19	25.98	16.67
SEm±	0.11	0.16	0.13	0.39	1.57	1.96	0.42	0.37	0.24
CD (p=0.05)	NS	NS	0.38	NS	NS	NS	NS	NS	0.68
CV %	6.14	6.05	6.19	6.12	6.14	6.15	6.17	6.17	5.98
G x F	NS	NS	NS	NS	NS	NS	NS	NS	NS
Y x G	NS	NS	NS	NS	NS	NS	NS	NS	NS
Y x F	NS	NS	NS	NS	NS	NS	NS	NS	NS
Y x G x F	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: G_1 (25 cm x 10 cm), G_2 (25 cm x 7.5 cm), G_3 (25 cm x 5.0 cm) and F_1 (40:25:20 kg ha^{-1} NPK), F_2 (50:35:25 kg ha^{-1} NPK) & F_3 (60: 45:30 kg ha^{-1} NPK).

different crop geometries. Highest number of umbels plant^{-1} (42.53), umbellates umbel^{-1} (8.00) and maximum seed yield (1137.71 kg ha^{-1}) were obtained by growing plants at a geometry of 25 cm x 7.5 cm (G_2 treatment). This might be due to proficient consumption of nutrients and sunshine. Profuse branching, vigorous vegetative growth and higher biomass accumulation in coriander plants led to the improvement in yield attributing characters of the crop due to optimum plant spacing which facilitate relatively higher nutrient uptake from the soil strata. Sufficient supply of photosynthates and plant metabolites because of increased plant biomass might have enhanced the branching, flower initiation and retention of flowers which consequently led to better seeds formation and their development. This was ultimately reflected in per plant seed yield enhancement which finally resulted into higher seed yield per unit area. It might be because of optimal spacing as it provides enough water (Lal *et al.*, 2013), nutrients, light and air required for better plant growth and development. By sowing at optimum or wider spacing, higher yield potential of individual plant is achieved. However, if sown with close spacing which resulted into dense plant

population, competition among plants will be high for vegetative growth influence umbel size and yield of the plants (Diwan *et al.*, 2018). On the other hand, the per unit area yield is enhanced on account of efficient use of plant growth influencing factors of source to sink. Since the closer spacing reduced the space for plant spread, it might have reduced the amount of nutrient consumption and delayed the attainment of reproductive growth phase leading to delayed emergence of umbels and hence late maturity and many a times reduced yield level (Meena *et al.*, 2013). These findings are in the conformity with the results of Kumar *et al.* (2006); Pawar *et al.* (2007); Patel *et al.* (2013); Shanu *et al.* (2013); Jamali & Martirosyan (2013) & Moniruzzaman *et al.* (2013).

Influence of nutrition on plant growth and seed yield

The results (Table 1 & 2) revealed that the germination speed of coriander (AGCr-1) seed was not affected significantly by different treatments of nutrients. However, minimum time to germination initiation (7.50 DAS) and completion of germination (11.25 DAS) were recorded under F_2 treatment (50:35:25 kg ha^{-1} NPK). In vegetative growth attributes, plant height at 30 DAS, number of basal leaves $plant^{-1}$ and secondary branches $plant^{-1}$ were significantly affected with different treatments of nutrients. The highest plant height at 30 DAS (9.72 cm), with maximum number of basal leaves plant-1 (16.67) and secondary branches $plant^{-1}$ (30.63) were registered under F_3 treatment (60:45:30 kg ha^{-1} NPK). The results of the study further revealed that the other growth parameters of plant growth and development were not affected significantly with different levels of fertilizers. Though, plant height at 60 DAS (27.75 cm), plant height at 90 DAS (110.20 cm), plant height at harvest (135.80 cm), first leaf length (29.19 cm), second leaf length (25.98 cm) and number of primary branches (8.01) were maximum in F_3 treatment (60:45:30 kg ha^{-1} NPK). Number of umbels $plant^{-1}$ and seed yield were affected significantly due to different treatments of nutrients, though number of umbellates $plant^{-1}$ did not alter significantly. The maximum number of umbels $plant^{-1}$ (43.41) and maximum seed yield (1145 kg ha^{-1}) were recorded with F_3 treatment (60:45:30 kg ha^{-1} NPK). Higher seed yield with appropriate plant growth and development observed in the present study might be due to sufficient supply of major nutrients particularly nitrogen which is associated with high photosynthetic activity leading to vigorous plant growth and physiologically healthier and stout plant morphology. Phosphorus is another important major nutrient which helps in transfer of energy from sunlight to plants, stimulates early rooting and plant growth, and hastens seed development and maturity. The third important nutrient for plants, potassium increases plant growth and yield and improves the quality coriander seed besides its to resist biotic and abiotic stresses. Accumulation of dry matter might have also increased due to balanced nutrition (Lal & Sen 2001). These results are in close conformity with the findings of Tehlan & Thakral (2008); Bhunia *et al.* (2009) and Sharangi *et al.* (2011); Patel *et al.* (2013) and Shanu *et al.* (2013); Jamali & Martirosyan (2013); Mehta *et al.* (2013); Lal *et al.* (2018); Pooja *et al.* (2017) and Singh *et al.* (2018); Lal *et al.* (2020).

Interaction effect on plant growth and yield

The coriander yield was affected significantly by the interaction effects of crop geometry and nutrient levels (Fig. 1). In pooled data of two years showed that the highest seed yield (1253.0 kg ha^{-1}) was obtained under G_2F_3 treatment combination (25 cm x 7.5 cm geometry with 60:45:30 kg ha^{-1} NPK). The productivity enhancement with higher nutritional dose at optimal plant geometry could be the result of high dry matter accumulation for grain development due to robust and healthy plants which harvested maximum photosynthetically active radiation. Higher number of leaves $plant^{-1}$ might have supplied additional surface

Table 2. Effect of plant geometry and nutritional levels on the yield and yield attributing characters (Pooled 2015-16 and 2016- 17).

Treatment	No. of primary branches plant^{-1}	No. of secondary branch plant^{-1}	No. of umbels plant^{-1}	No. of umbellates umbel^{-1}	Seed yield (kg ha^{-1})
Plant Geometry					
G_1	7.73	29.21	41.68	7.83	1014.86
G_2	7.94	30.22	42.53	8.00	1137.71
G_3	7.93	29.88	42.38	7.91	1106.28
SEm±	0.11	0.43	0.61	0.12	15.59
CD (p=0.05)	NS	NS	NS	NS	44.90
Fertilizer Levels					
F_1	7.75	28.47	40.44	7.81	1060.59
F_2	7.84	30.22	42.74	7.92	1052.92
F_3	8.01	30.63	43.41	8.01	1145.35
SEm±	0.11	0.43	0.61	0.12	15.59
CD (p=0.05)	NS	1.25	1.77	NS	44.90
CV %	6.14	6.18	6.17	6.17	6.09
G x F	NS	NS	NS	NS	S
Y x G	NS	NS	NS	NS	NS
Y x F	NS	NS	NS	NS	NS
Y x G x F	NS	NS	NS	NS	NS

Note: G_1 (25 cm x 10 cm), G_2 (25 cm x 7.5 cm), G_3 (25 cm x 5.0 cm) and F_1 (40:25:20 kg ha^{-1} NPK), F_2 (50:35:25 kg ha^{-1} NPK) & F_3 (60: 45:30 kg ha^{-1} NPK).

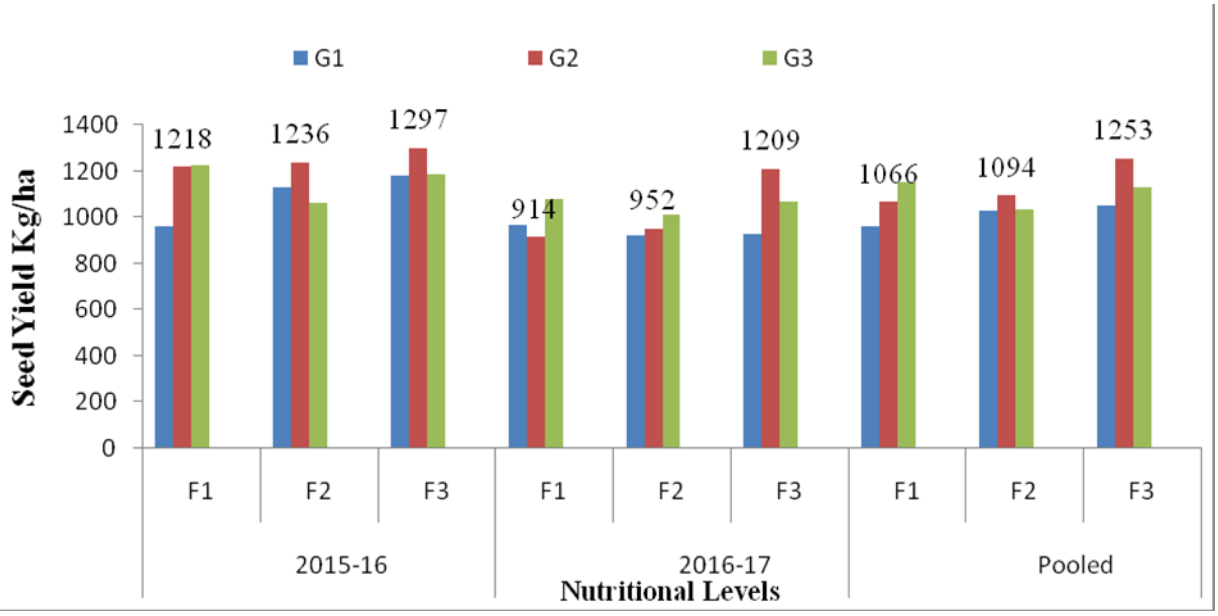

Fig. 1. Interaction between plant geometry and nutritional levels on seed yield kg ha^{-1} of coriander.

area for photosynthesis and production of assimilates. These findings corroborate the findings of Lal *et al.* (2020) and Kurubetta *et al.* (2018) in coriander.

In conclusion the results of two years investigation, revealed that maximum seed yield of AGCr-1 coriander with luxurious plant growth and quality produce was obtained, when it was sown at 25 cm x 7.5 cm (Row x Plant) spacing with the application of 60:45:30 kg ha^{-1} NPK in semi-arid agro-climatic conditions of Rajasthan.

References

Bhuiyan N, Begum J & Sultana M 2009 Chemical composition of leaf and seed essential oil of coriander (*Coriandrum sativum* L.) from Bangladesh. Bangladesh J. Pharmacol. 4(2): 150–153.

Bhunia S R, Ratnoo S D & Kumawat S M 2009 Effect of irrigation and water use, moisture extraction pattern, nitrogen uptake and yield of coriander (*Coriandrum sativum* L.) in north western irrigated plains of Rajasthan. J. Spices Arom. Crops. 18(2): 88–91.

Diwan G, Bisen B P & Maida P 2018 Effect of nitrogen doses and row spacing on growth and seed yield of coriander (*Coriandrum sativum* L). Int. J. Chem. Stud. 6(4): 2768–2772.

Jamali M M & Martirosyan 2013 Evaluation of the effect of water deficit and chemical fertilizers on some characteristics of coriander (*Coriandrum sativum* L). Int. J. Agron. 4(3): 413–417.

Kumar A 2004 Standardization of seed production techniques in fenugreek, M. Sc. (Agri.) Thesis, Uni. of Agric. Sci. Dharwad (India).

Kumar K, Singh G P, Singh N & Nehra B K 2006 Effect of row spacing and cycocel on growth and seed yield of coriander (*Coriandrum sativum* L.) Haryana J. Hortic. Sci. 35 (3&4): 350.

Kurubetta K D, Mesta R K, Allolli T B, Tatagar M H, Kareem M A & Sweta K 2018 Effect of Spacing and Fertilizer Dose on Seed Yield and Economics of Coriander (*Coriandrum sativum* L.). Bulletin of Environment, Pharmacology and Life Science, 7(4): 11–13.

Lal G Meena R S & Choudhary M K 2018 Evaluation of coriander varieties for green leaf yield in off season under shade nets. Int.J. Seed Spices. 8(2):12–16.

Lal G, Lal S, Choudhary M K, Meena R S & Shekhawat N 2020 Growth, yield and essential oil of coriander (*Coriandrum sativum* L.) variety ACr-2 as influenced by various nutrient levels and crop geometry. Int. J. Chem Stud. 8(4): 2749–2752.

Lal G, Mehta R S, Singh S R, Kakani R K, Meena N K & Maheria S P 2016 Effects of nitrogen levels on plant growth and leaf yield of off season coriander under shade nets. Int. J. Seed Spice. (2):46–49.

Lal G, Saini I P, Mehta R S, Maheria S P & Sharma Y K 2013 Effect of irrigation and different seed treatments methods on growth and yield of fenugreek *(Trigonella foenum graecum* L.). Int. J. Seed Spices. 3 (2): 29–33.

Lal G & Sen N L 2001 Effect of N, Zn and Mn Fertilization on Fruit quality of Guava (*Psidium guajava* L.) Cv. Allahabad Safeda. Haryana J. Hort Sci. 30 (3&4): 209–210.

Luaza G, Brevendan R & Palomo R 1996 Coriander under irrigation in Argentina. In: Janick, J. (Ed) Progress in New Crops. ASHS Press, Arlington, pp590–594.

Mazumdar S N, Moninuzzaman M, Rahman S M M & Basak N C 2007 Influence of support systems and spacing on hyacinth bean production in the eastern hilly area of Bangladesh. Legume Research, 30(1): 1–9.

Meena R L, Meena S S, Mehta R S, Meena R D & Saini Y 2015 Response of varying nitrogen and phosphorus levels on growth and yield of Anise (*Pimpinella anisum* L.). Int. J. Seed Spices, 5(1): 83–87.

Meena S S, Mehta R S, Lal G & Anwer M M 2013 Economic feasibility of weed management in fenugreek. Indian J Hortic. 70 (1): 150–153.

Mehta R S, Lal G & Vishal M K 2013 Growth and yield of coriander (*Coriandrum sativum* L.) as influenced by irrigation and nutrient levels with varying crop geometry. Annals of Agricultural Research New Series. 34(3): 205–209.

Moniruzzaman M, Rahman M M, Hossain M M, Sirajul Harim A J M & Khaliq Q A 2013 Effect of seed rate and sowing method on foliage production of different genotypes of coriander (*Coriandrum Sativum* L.), Bangladesh J. Agric. Res. 38(3): 435–445.

Nayak B R, Samanta P K, Dashand A K & Swain S K 2013 Growth and yield of coriander (*Coriandrum sativum* L.) as influenced by different levels of farm yard manure, nitrogen and plant spacings, An Asian J. Soil Sci. 8(2): 198–S201.

Panse V G & Sukhatme P V 1985 Statistical methods for Agricultural workers, 4th Enlarged Edition, Indian Council of Agricultural Research Pub. New Delhi.

Patel C B, Amin A U & Patel A L 2013 Effect of varying levels of nitrogen and sulphur on growth and yield of coriander (*Coriandrum sativum* L.). The Bioscan, 4: 1285–1289.

Pawar P M, Naik D M, Damodhar V P, Shinde V N & Bhalerao R V L 2007 Influence of graded levels of spacing and nitrogen on growth and yield of coriander (*Coriandrum sativum* L.). The Asian J. Hortic. 2(1): 58–60.

Pooja, Nagre P K & Yadav H 2017 Influence of different levels of nitrogen and phosphorus on seed yield and economics of coriander (*Coriandrum sativum* L.), J. Pharma and Phytochem. 6(5): 157–160.

Shanu I S, Naruka P P, Singh R P, Shaktawat S & Verma K S 2013 Effect of seed treatment and foliar spray of thiourea on growth, yield and quality of coriander (*Coriandrum sativum* L.) under different irrigation levels, Int J. Seed Spices. 3(1): 20–25.

Sharangi A B, Chatterje, R, Nanda M K & Kumar R 2011 Growth and leaf yield dynamics of cool season coriander as influenced by cutting and foliar nitrogen application. J. Plant Nutri. 34(12): 1762–1768.

Singh H, Panghal V P S & Duhan D S 2018 Irrigation and nutritional effect on growth and seed yield of coriander (*Coriandrum sativum* L.). J. Plant Nutri. 41(13): 1705–1710.

Spice Board India database (adv. Est.) 2020-21. http://www.indianspices.com

Tatero K & Ojima M 1973 Growth analysis of grain sorghum as affected by planting density and amount of nitrogen. Proceedings of the Crop Science Society of Japan, 42(4): 555–559.

Tehlan S K & Thakral K K 2008 Effect of different levels of nitrogen and leaf cutting on leaf and seed yield of coriander (*Coriandrum sativum* L). J. Spices Arom. Crops, 17(2): 180–182.