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Evaluation of growth and yield responses of gram (*Cicer arietinum* L.) to antitranspirants and foliar fertilization under irrigated conditions

TWINKLE AND KAMALESH KUMAR
General Shivdev Singh Diwan Gurbachan Singh Khalsa College, Patiala, 147001

Abstract

*A research experiment entitled "Evaluation of growth and yield responses of gram (*Cicer arietinum *L.) under irrigation conditions" was conducted at Campus for Research and Advanced Studies, Dhablan, G.S.S.D.G.S. Khalsa college, Patiala during* rabi *season of 2021-2022. The experiment was designed in Factorial Randomized Block Design with 15 treatments and treatments were replicated thrice. The treatments included different Antitranspirants (A_1: Glycerol 5%, A_2: Phenyl mercuric acetate 0.05% and A_3: Sodium Carbonate 5%) and different Liquid fertilizers (LF_1: 2% Panchagavya solution, LF_2: 5% Panchagavya solution, LF_3: 2% Urea solution + 1% DAP solution + 2% Panchagavya solution, LF_4: 3% Urea solution + 2% DAP solution + 5% Panchagavya solution and LF_5: 5% Panchagavya solution + 5% Jeevamrut). There was a significant effect of antitranspirants on growth and yield of gram. The research findings revealed the higher growth parameters such as plant height, number of branches plant^{-1}, fresh weight plant^{-1} and dry weight plant^{-1} with the application of Glycerol 5% and 3% Urea solution + 2% DAP solution + 5% Panchagavya solution at 30, 60, 90 DAS and at harvest.*

Keywords: Gram, Antitranspirants, foliar fertilization, Glycerol, Phenyl mercuric acetate, Sodium carbonate, Urea, DAP, Panchagavya

Introduction

Gram (*Cicer arietinum* L.) is member of the Fabaceae family with chromosome no. 2n = 14. Gram is a pulse crop as we know that pulses play an important role in Indian diet and a major source of protein, some essential amino acids. *Cicer arietium* word is derived from the Roman word, which was originated in South-West Asia.

Gram is a winter crop, but it is sensitive to cold and frost. Frost at the time of flowering causes the flowers to fail to develop seeds or kills the seeds inside the pods. It is typically grown under ranifed conditions, but it also performs well under irrigated conditions. Execessive rains soon after sowing, during flowering and fruiting, or hailstorms during ripening cause significant losses. It works best in

the areas with moderate rainfall of 60-90 cm per year. Though gram can be grown in a variety of soil types, sandy loam to clay loam is thought to be the best. It grows best in soil that is well-drained and not too heavy.

Amazing sources of protein, carbs, amino acids, iron, phosphorus, thiamin, niacin, vitamin B_6, and folic acid are found in gram seeds. In 2020, world production of gram was about 15 million of tonnes, which was led by India with 73% of the total and turkey (0.6%), Myanmar (0.5%) and Pakistan (0.5%) as peripheral producers. In India, gram growing states are Madhya Pradesh, Uttar Pradesh, Rajasthan, Maharashtra, Andhra Pradesh and Telangana.

Foliar feeding is a method of providing plants with nutrients by drizzling liquid fertilizer directly onto the plant canopy. Foliar spraying can supply the nutrients necessary for the growth and development when the plant is unavailable to obtain the nutrients from the soil (Basant *et al*. 2020). Foliar applications

during the crop's developing stages improve its nutritional balance by quickly and efficiently supplying the needed plant nutrients. They speed up the important plant minerals' quick absorption, which in turn helps plant respond to their needs more successfully, leading to an improvement in quality, yield, or both.

Transpiration causes the plant to lose around 95% of the water it takes in. The chemical substance known as an antitranspirant works to slow down the rate of transpiration from plant leaves by lowering the size and quality of stomata. The foliar spray of antitranspirants helps in improving the photosynthesis and reduces the transpiration rate which causes a better production of crops. Some fungicides and herbicides, such as phenyl mercuric acetate (PMA) and atrazine, act as antitranspirants (Zelitch and Waggoner, 1962). These could inhibit photosynthesis.

Panchagavya in Sanskrit means the blend of five products obtained from cow dung, urine, milk, curd and ghee. It is an organic product which play great role in promoting growth and providing immunity in the plant system whereas presence of naturally occurring, beneficial and effective microorganisms in panchagavya, improved soil quality, growth and yield of crops. It acts as growth promoter (75%) and immunity booster (25%) and exactly fills the missing link to sustain the organic farming without any yield loss (Vedivel, 2007).

Materials and methods

The experiment field was located at G.S.S.D.G.S. Khalsa College Patiala, Campus for Research and Advanced studies Agricultural Research Farm Dhablan. The coordinates are 30.33^0N (North Latitude) and 76.28^0E (East Longitude). It has an average elevation of 250 metres above sea level. It is located in Punjab state and North West India. The location is in the Indo-Gangetic plains.

During the *Rabi* season 2021-2022 the maximum temperature of 38.96^0C and minimum temperature 5.47^0C was recorded. The relative humidity of 99.63% was observed. The total weekly rainfall of 15.04 mm and 10.46 mm was received during the crop period. The experiment was laid out in factorial randomized block design with 15 treatments; all treatment was replicated three times. Variety PBG 5 was cultivated with the spacing of 30 × 15 cm. The seed rate of crop was 80 kg ha^{-1}.

All the growth parameters were recorded at 30, 60, 90 DAS and at harvest. All the data recorded during the investigation were subjected to Analysis of variance (ANOVA) as described by Gomez and Gomez (1984) for using Randomized Block Design at 5% level of significance.

Results and Discussion

Plant height (cm):

Plant height is directly related to seed yield as taller plants results in more number of branches and leaves. The data on plant height (cm) of gram was recorded at 30, 60, 90 DAS and at harvest, which is presented in the Table 1 and illustrated graphically in Graph 1(a) and Graph 1(b).

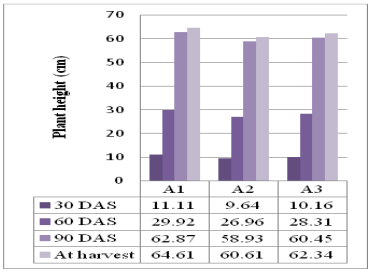
Glycerol application (5%) showed the maximum plant height (11.11, 29.92, 62.87 and 64.61 cm) at 30, 60, 90 DAS and at harvest, respectively. Minimum plant height (9.64, 26.96, 58.93 and 62.34 cm) at 30, 60, 90 DAS and at Harvest was recorded with the application of phenyl mercuric acetate (0.05%). Antitranspirants such as glycerol found to boost metabolism and anabolic functions. Similar findings were observed by Sanbagavalli *et al.* (2017).

Different types of foliar fertilizations significantly respond to the plant height at all different stages of crop growth. The highest plant height (11.83, 31.60, 65.43 and 67.35 cm) at 30, 60, 90 DAS and at harvest was recorded with the foliar application of 3% Urea solution + 2% DAP solution + 5% Panchagavya solution at 20, 40, 60 DAS whereas it was statistically at par with the foliar application of 2% Urea solution + 1% DAP solution + 2% Panchagavya solution and recorded plant height (11.29, 30.96, 64.75 and 66.84 cm) at 30, 60, 90 DAS and at harvest, respectively. The increase in the plant height is due to quick availability of essential plant nutrients for the growth and development of plants, which enhances the production of photosynthetic assimilates from increased photosynthesis rate whereas the presence of growth hormones and enzymes in panchagavya helps in rapid cell division and elongation. The similar results are reported by Mudalagiriyappa *et al.* (2013) and Kumar *et al*. (2011).

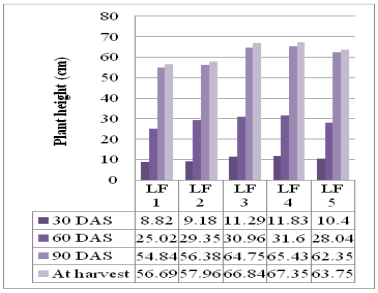
Number of branches plant^{-1}

Table 1: Evaluation of plant height (cm) of gram to antitranspirants and foliar fertilization under irrigated condition.

Treatment	Plant height (cm)			
	90 DAS	60 DAS	90 DAS	A t harvest
Antitranspirants				
A_1: Glycerol 5%	11.11	29.92	62.87	64.61
A_2:Phenyl mercuric acetate 0.05%	9.64	26.96	58.93	60.61
A_3: Sodium carbonate 5%	10.16	28.31	60.45	62.34
SEm±	0.48	0.50	0.55	0.78
CD (P=0.05)	0.87	1.03	1.12	1.59
Liquid Fertilizers				
LF_1: 2% Panchagavya solution	8.82	25.02	54.84	56.69
LF_2: 5% Panchagavya solution	9.18	29.35	56.38	57.96
LF_3: 2% Urea solution + 1% DAP solution + 2% Panchagavya solution	11.29	30.96	64.75	66.84
LF_4: 3% Urea solution + 2% DAP solution + 5% Panchagavya solution	11.83	31.60	65.43	67.35
LF_5: 5% Panchagavya solution + 5% Jeevamrut	10.40	28.04	62.35	63.75
SEm±	0.49	0.58	0.63	0.90
CD (P=0.05)	1.01	1.18	1.30	1.84



Graph 1(a): Evaluation of plant height (cm) of gram to antitranspirants under irrigated condition



Graph 1(b): Evaluation of plant height (cm) of gram to foliar fertilization under irrigated condition

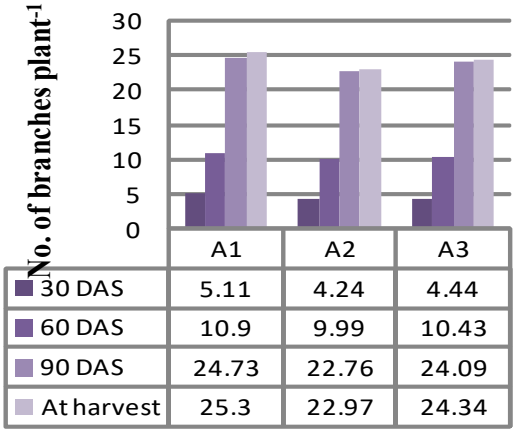
The data of number of branches plant^{-1} was recorded at 30, 60, 90 DAS and at harvest, which is tabulated in Table 2 and illustrated graphically in Graph 2(a) and Graph 2(b).

During the early stages of growth (30 DAS), number of branches plant^{-1} were found to be very low. Whereas maximum number of branches plant^{-1} (5.11) at 30 DAS was recorded with the application of glycerol 5%. At 60, 90 DAS and at harvest number of branches plant^{-1} were recorded as 10.90, 24.73 and 25.30 with the application of antitranspirant glycerol 5%. Similar findings were observed by Sanbagavalli *et al.* (2017). Minimum number of branches plant^{-1} (4.24, 9.99, 22.76 and 22.97) at 30, 60, 90 DAS and at harvest was observed with the application of phenyl mercuric acetate 0.05%.

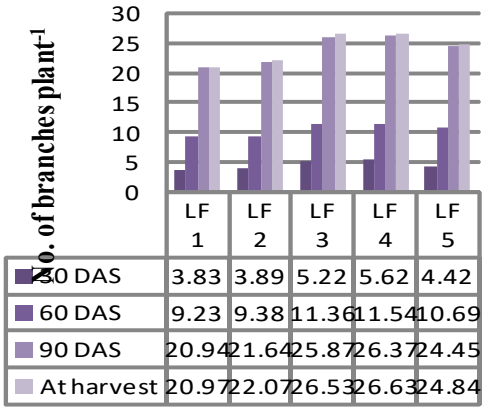
The highest number of branches plant^{-1} (5.62, 11.54, 26.37 and 26.63) at 30, 60, 90 DAS and at harvest was recorded with the foliar application of 3% Urea solution + 2% DAP solution + 5% Panchagavya solution. It was significantly at par with the application of 2% Urea solution + 1% DAP solution + 2% Panchagavya solution at 60, 90 DAS and at harvest and number of branches recorded were 11.36, 25.87 and 26.53, respectively. Increase in the number of branches plant^{-1} is due to supply of nitrogen, phosphorous and potassium to gram through foliar nutrition, which may have accelerated metabolic process and resulted in maximum number of branches. Similar results were reported by Kumar *et al*. (2008).

Table 2: Evaluation of number of branches plant^{-1} of gram to antitranspirants and foliar fertilization under irrigated conditions

Treatment	No. of branches plant^{-1}			
	30 DAS	60 DAS	90 DAS	At harvest
Antitranspirants				
A_1: Glycerol 5%	5.11	10.90	24.73	25.30
A_2:Phenyl mercuric acetate 0.05%	4.24	9.99	22.76	22.97
A_3: Sodium carbonate 5%	4.44	10.43	24.09	24.34
SEm±	0.11	0.14	0.22	0.42
CD (P=0.05)	0.22	0.28	0.46	0.91
Liquid Fertilizers				
LF_1: 2% Panchagavya solution	3.83	9.23	20.94	20.97
LF_2: 5% Panchagavya solution	3.89	9.38	21.64	22.07
LF_3: 2% Urea solution + 1% DAP solution + 2% Panchagavya solution	5.22	11.36	25.87	26.53
LF_4: 3% Urea solution + 2% DAP solution + 5% Panchagavya solution	5.62	11.54	26.37	26.63
LF_5: 5% Panchagavya solution + 5% Jeevamrut	4.42	10.69	24.45	24.84
SEm±	0.12	0.16	0.26	0.49
CD (P=0.05)	0.25	0.33	0.53	1.05



Graph 2(a): Evaluation of number of branches plant^{-1} of gram to antitranspirants under irrigated conditions



Graph 2(b): Evaluation of number of branches plant^{-1} of gram to foliar fertilization under irrigated conditions

Fresh weight plant^{-1} (g)

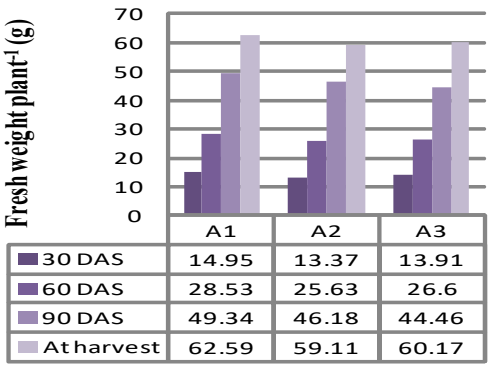
Data of fresh weight plant^{-1} (g) was recorded at 30, 60, 90 DAS and at harvest, which is represented in Table 3 and depicted graphically in Graph 3 (a) and Graph 3(b).

At 30, 60, 90 DAS and at harvest, fresh weight plant^{-1} was recorded as 14.95, 28.53, 46.34 and 63.59 g, respectively with the application of glycerol 5%. There was no at par observed with this application of phenyl mercuric acetate 0.05% and fresh weight plant^{-1} recorded was 13.37, 25.63, 43.18 and 59.11 g at 30, 60, 90 DAS and at harvest, respectively.

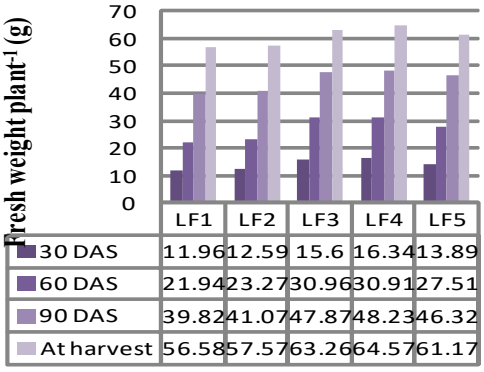
With the application of 3% Urea solution + 2% DAP solution + 5% Panchagavya solution fresh weight plant^{-1} recorded was 16.34, 30.91, 48.23 and 64.57g at 30, 60, 90 DAS and at harvest, respectively. It was statistically at par with the application of 2% Urea solution + 1% DAP solution + 2% Panchagavya solution at 30, 60 and 90 DAS, fresh weight plant^{-1} recorded was 15.60, 30.96 and 47.87g, respectively. Foliar application of nutrients helps in increasing the microbial activities, increases the soil fertility and hence increases the plant growth attributes. Ganga *et al*. (2013) also showed the similar results.

Table 3: Evaluation of fresh weight plant^{-1} (g) of gram to antitranspirants and foliar fertilization under irrigated conditions

Treatment	Fresh weight plant^{-1} (g)			
	30 DAS	60 DAS	90 DAS	At harvest
Antitranspirants				
A_1: Glycerol 5%	14.95	28.53	49.34	62.59
A_2:Phenyl mercuric acetate 0.05%	13.37	25.63	46.18	59.11
A_3: Sodium carbonate 5%	13.91	26.60	44.46	60.17
SEm±	0.37	0.51	0.53	0.51
CD (P=0.05)	0.76	1.05	1.08	1.03
Liquid Fertilizers				
LF_1: 2% Panchagavya solution	11.96	21.94	39.82	56.58
LF_2: 5% Panchagavya solution	12.59	23.27	41.07	57.57
LF_3: 2% Urea solution + 1% DAP solution + 2% Panchagavya solution	15.60	30.96	47.87	63.26
LF_4: 3% Urea solution + 2% DAP solution + 5% Panchagavya solution	16.34	30.91	48.23	64.57
LF_5: 5% Panchagavya solution + 5% Jeevamrut	13.89	27.51	46.32	61.17
SEm±	0.43	0.59	0.61	0.58
CD (P=0.05)	0.88	1.21	1.24	1.20



Graph 3(a): Evaluation of fresh weight plant^{-1} (g) of gram to antitranspirants under irrigated conditions



Graph 3(b): Evaluation of fresh weight plant^{-1} (g) of gram to foliar fertilization under irrigated conditions

Dry weight plant^{-1} (g)

Data on dry weight plant^{-1} (g) were recorded at 30, 60, 90 DAS and at harvest, which is tabulated in Table 4 and illustrated graphically in Graph 4(a) and Graph 4(b).

The application of Glycerol 5% showed highest dry weight plant^{-1} i.e. 5.20, 12.62, 19.26 and 28.24 g at 30, 60, 90 DAS and at harvest, respectively. Whereas minimum dry weight plant^{-1} was obtained with the application of phenyl mercuric acetate 0.05% i.e. 4.10, 10.81, 17.29 and 24.64 g at 30, 60, 90 DAS and at harvest. Similar findings were observed by Sanbagavalli *et al*. (2017).

The maximum dry weight plant^{-1} was obtained with the application of 3% Urea solution + 2% DAP solution + 5% Panchagavya solution i.e. 5.99, 13.67, 20.54 and 29.99 g at 30, 60, 90 DAS and at harvest, respectively. It is statistically at par with the application of 2% Urea solution + 1% DAP solution + 2% Panchagavya solution at 60 and 90 DAS and dry weight plant^{-1} observed was 13.05 and 19.82 g. the availability of macro and micro nutrients to plants helps in increasing the dry matter accumulation in plants. The similar results are reported by Kumari *et al*. (2019) and Saranraj *et al*. (2011).

Conclusion

On the basis of the results obtained during the investigation, the antitranspirants Glycerol 5% showed significantly higher results of growth, yield and economics at all the stages of crop.

On the other hand, the application of 3% Urea solution + 2% DAP solution + 5% Panchagavya solution gave significantly higher results of growth, yield and economics at all the stages. This might be due to availability of all the macro and micro nutrients at all different stages.

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