Biological Forum – An International Journal **13(3a): 483-486(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of Pruning and Foliar Application of Brassinosteroid and Salicylic acid on Growth, Yield and Quality of Phalsa (*Grewia subinaequalis* L.)

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(Received 07 July 2021, Accepted 21 September, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: To improve the vegetative growth, yield, and quality of the phalsa, the present Experiment was carried out during 2020 December to 2021 May in the Horticulture Research farm and laboratory, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Science, Prayagraj. The experimental field was laid out in Randomized Block Design (RBD) with seven treatments and three Replications of different combinations. The variety used in this experiment was Sharbati. The experiment comprised two foliar applications consisting of Brassinosteroid @5mg/l, Brassinosteroid@10mg/l, Brassinosteroid @15mg/l, salicylic acid 300ppm, salicylic acid@500ppm, salicylic acid@700ppm with control. Experiment results revealed that the imposition of the different treatments had a significant effect on improving the vegetative growth, yield, and quality of the phalsa plants. The results of the study indicated that the treatment T_4 Brassinosteroid @ 15 mg/l was superior in respect of the parameters viz., number of canes per bush (16.62), number of sprouted shoots per canes (11.36, 13.89, 23.11 and 27.07), length of shoots (cm) (37.70, 53.30, 70.18 and 85.33), number of fruiting nodes per shoots (12.44, 13.65, 20.72 and 27.91), tss (°Brix) (26.33), fresh weight of 100 fruit (g) (85.62), juice percent of phalsa (57.80), fruit yield (t ha^{-1}) (17.44). Hence T_4 was found superior based on above parameters.

Keywords: Phalsa, Growth, Brassinosteroid, Salicylic acid.

INTRODUCTION

Phalsa (*Grewia subinaequalis* L) is a subtropical fruit that belongs to the family Tiliaceae with chromosome number (2n=36). Its fruit type is a berry. India is considered to be the home of phalsa. It is a quick-growing very hardy shrub that thrives well in the arid and semi-arid region. Tiliaceae is one of the hardy tropical and Subtropical fruit plants, withstand drought and is grown under adverse climatic conditions. It can be cultivated on neglected and poor soils. It is also grown as an inter-crop in mango, aonla, bael and ber commercial orchards. The ripe fruits of phalsa are deep reddish-brown, sour in taste with a desired and pleasant flavor. Phalsa cultivation is favored around big cities where fruits have good demand in the market.

The genus Grewia is mostly distributed in Africa, Asia and Australia and consists of nearly 40 species of genus Grewia are found in India some are climbers, shrubs, or trees. This family has about 41 genera and 400 species, which are mostly distributed in the tropical and sub-tropical regions of the world. In India, it is an indigenous fruit and commercially cultivated in the states of Punjab, Haryana, Rajasthan, Uttar Pradesh, Madhya Pradesh, West Bengal, Gujarat, Maharashtra and Andhra Pradesh. Phalsa fruit contains higher medicinal and nutritional benefits.

The ripe phalsa fruits are consumed fresh, or processed into refreshing fruit and soft drinks. The fruits are excellent for processing into quality beverages, ready to serve, nectar, syrup and squash. Ripe fruits are sub acidic in taste and rich source of vitamin A (16.11µg/100 g fruit) vitamin C (22 mg/100 g fruit) and minerals (Sharma *et al.,* 2008). Nutritive value of Phalsa is 725 calories/kg, edible fruit moisture- 81.13%; protein- 1.58%, fat-1.82%, crude fiber-1.77% and sugar- 10.27% (Morton, 1987). Fruits contain 50-60% juice, 10-11% sugar and 202.5% acid (Aykrod, 1983).

Brassinosteroids are a new group of polyhydroxy steroids that have been recognized as a class of phytohormones. Brassinosteroids play prominent roles in many developmental processes including the increase of cell elongation, pollen tube growth, flowering, fruit set (Işç and Gökbayrak 2015) senescence, abscission and maturation (Swamy and Rao, 2008).

Salicylic acid is also an endogenous growth regulator with phenolic nature, which participates in the regulation of several physiological processes in plants, such as stomata closure, ion uptake, inhibition of ethylene biosynthesis and transpiration (Bindhyachal *et al.,* 2016).

MATERIALS AND METHODS

The experiment was carried out in the agro-climatic conditions of Prayagraj in department of horticulture, Naini Agricultural Institute. The region located on the right bank of the Yamuna, 6 kilometers south of Prayagraj city, on the Rewa road. It is located at 25°57' North latitude, 81°51' East longitude, and is 98 meters above sea level (MSL) this can be represented by Fig. 1.

Fig. 1. Location of Prayagraj district in Uttar Pradesh state (India).

Prayagraj district is located in Uttar Pradesh's subtropical region, which has very hot summers and relatively mild winters. The location's highest temperature ranges from 46°C to 48°C, with temperatures seldom falling below 4°C or 5°C. The relative humidity levels range from 20% to 94%. The average yearly rainfall in this area is about 1013.4 mm.

RESEARCH METHOD

15 years old phalsa plants were selected and pruned to sixty centimeters above the ground level. The pgr were applied twice. The first sprayed at pre-bloom stage and the second spray just after fruit set. The length and width of fruit size were recorded with the help of the venire calipers. The weight of the fresh fruits has been taken by electronic balance and chemical analysis was done to determine the quality of the fruit.

Before pruning Pruning After pruning

Table 1: Details of treatments combination.

Treatment Notation	Treatments details
T_1	Control
T_2	Brassinosteroid @ 5 mg/l
T_3	Brassinosteroid @ 10mg/l
T_4	Brassinosteroid @ 15 mg/l
T_5	Salicylic acid @ 300 ppm
T_6	Salicylic acid @ 500 ppm
T_7	Salicylic acid @ 700 ppm

RESULTS AND DISCUSSION

According to the data in Table 2 and Fig. 2,

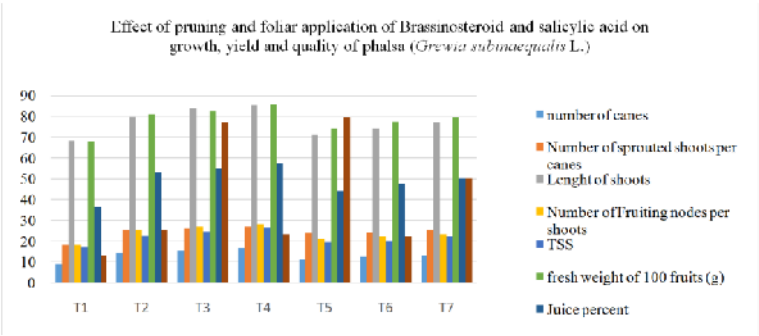

Fig. 2. Effect of pruning and foliar application of Brassinosteroid and Salicylic acid on growth, yield and quality of phalsa (*Grewia subinaequalis L*).

Number of canes per Bush: The effect of Brassinosteroid (@5 mg/l, 10mg/l and 15mg/l) and salicylic acid (@300 ppm, 500 ppm, 700 ppm) the maximum number of canes per bush (16.62) was recorded with the T_4 Brassinosteroid @ 15 mg/l whereas the minimum number of canes per bush (9.06) was found in T_1 Control, Rawat *et al*., (1998) also reported similar results.

Number of spourted shoots per canes The effect of Brassinosteroid (@5 mg/l, 10mg/l and 15mg/l) and salicylic acid (@300 ppm, 500 ppm, 700 ppm) the maximum Number of sprouted shoots per canes (11.36, 13.89, 23.11 and 27.07) was recorded with the T4 Brassinosteroid @ 15 mg/l whereas the minimum Number of sprouted shoots per canes (5.96, 8.29, 16.02 and 18.12) was found in T1 Control.

Table 2: Effect of pruning and foliar application of Brassinosteroid and Salicylic acid on growth, yield and quality of phalsa (*Grewia subinaequalis L.*)

Treatment Notation	Treatments details	Number of Canes per bush	Number of Sprouted Shoots Per canes	Length of shoots (cm)	Number of Fruiting nodes per shoots	TSS of fruit	Fresh weight of 100 fruit (g)	Juice Percent of phalsa	Fruit yield (t/ha)
T_1	Control	9.06	103.95	68.15	18.02	17.36	68.07	36.41	5.89
T_2	Brassinosteroid @ 5 mg/l	14.50	139.96	80.52	25.52	22.74	80.85	53.33	14.10
T_3	Brassinosteroid @ 10mg/l	15.18	143.63	84.08	27.07	24.55	82.44	55.10	15.66
T_4	Brassinosteroid @ 15 mg/l	16.62	147.48	85.33	27.91	26.33	85.62	57.80	17.44
T_5	Salicylic acid @ 300 ppm	11.01	122.43	71.07	21.01	19.52	74.60	44.17	10.07
T_6	Salicylic acid @ 500 ppm	12.46	123.56	74.51	22.13	20.11	77.62	47.80	11.27
T_7	Salicylic acid @ 700 ppm	13.01	129.43	77.02	23.17	22.35	79.71	50.15	12.48
	F-Test	S	S	S	S	S	S	s	S
	C.D.at 0.5%	1.274	4.707	3.445	1.598	1.493	4.106	2.518	1.132
	S.Ed (±)	0.585	2.16	1.581	0.734	0.685	1.884	1.156	0.519

Length of shoots (cm): The effect of Brassinosteroid (@5 mg/l, 10mg/l and 15mg/l) and salicylic acid (@300 ppm, 500 ppm, 700 ppm) the Maximum Length of shoots (cm) (37.70, 53.30, 70.18 and 85.33) was recorded with the T_4 Brassinosteroid @ 15 mg/l whereas the minimum Length of shoots (cm) (19.71, 34.21, 59.00, 68.15) was found in T_1 Control. The present findings are in conformity with those reported by Kumar and Kaur (2019).

Number of fruiting nodes per shoot: The effect of Brassinosteroid (@5 mg/l, 10mg/l and 15mg/l) and salicylic acid (@300 ppm, 500 ppm, 700 ppm) the maximum Number of fruiting nodes per shoot (12.44, 13.65, 20.72 and 27.91) was recorded with the T_4Brassinosteroid @ 15 mg/l whereas the minimum Number of fruiting nodes per shoots (6.10, 8.08, 13.06 and 18.02) was found in T_1 Control.The present findings are in conformity with those reported by Shinwari *et al.*, (2018).

TSS (°Brix) The effect of Brassinosteroid (@5 mg/l, 10mg/l and 15mg/l) and salicylic acid (@300ppm, 500ppm, 700ppm) the maximum TSS (°Brix) (26.33) was recorded with the T_4 Brassinosteroid @ 15 mg/l whereas the minimum TSS (°Brix) of phalsa (17.36) was found in T_1 Control.The present findings are in conformity with those reported by Jayalakshmi and Shakila (2017). The increase in total soluble solids and sugar percentage may be caused due to better formation and translocation of carbohydrates, starch hydrolysis and early maturation of fruits.

Fresh weight of 100 fruit (G) The effect of Brassinosteroid (@5 mg/l, 10mg/l and 15mg/l) and salicylic acid (@300ppm, 500ppm, 700ppm) the maximum Fresh weight of 100 fruit (g) (85.62) was recorded with the T_4 Brassinosteroid @ 15 mg/l whereas the minimum Fresh weight of 100 fruit (g) (68.07) was found in T_1 Control. These findings are in close conformity with Narayan *et al.*, (2013) in guava.

Juice Percent: The effect of Brassinosteroid (@5 mg/l, 10mg/l and 15mg/l) and salicylic acid (@300ppm, 500ppm, 700ppm) the maximum Juice percent (57.80) was recorded with the T4 Brassinosteroid @ 15 mg/l whereas the minimum Juice percent (36.41) was found in T1 Control.

Fruit Yield (HA): The effect of Brassinosteroid (@5 mg/l, 10mg/l and 15mg/l) and salicylic acid (@300ppm , 500ppm, 700ppm) the maximum Fruit yield (t/ha) (17.44) was recorded with the T_4 Brassinosteroid @ 15 mg/l whereas the minimum Fruit yield (t/ha) (5.89) was found in T_1 Control. The present findings are in conformity with those reported by Ramgiry and Sharma (2020). The present findings are in conformity with those reported by Ghorbani *et al*., (2017). Effects of brassinosteroid (24-epibrassinolide) on yield and quality of grape (*Vitis vinifera* L.) Thompson Seedless. Vitis 56:113-117.

CONCLUSION

From the foregoing discussion it is concluded that among the different suitable doses of brassinosteroid and salicylic acid significantly bore maximum number of canes per bush, number of sprouted shoots per canes, length of shoots (cm), number of fruiting nodes per shoots, tss (°Brix), fresh weight of 100 fruit (g), juice percent and fruit yield (t/ha), whereas treatment T_4 Brassinosteroid @15mg/l gave significantly higher growth, yield. Hence, for better growth and development it is recommended to apply the foliar application of brassinosteroidt 4@15mg/l at the pre-bloom stage in phalsa under prayagraj agro-climatic conditions.

FUTURE SCOPE

Brassinosteroid is also known for its role in the protection of plants from different stress situations including biotic stress such as the attack of different pathogens. Therefore, it can easily and efficiently replace different pesticides and fungicides. Which otherwise have health hazards and also degrade the environment.

Salicylic acid which is a secondary plant product performs important actions in the growth and development processes of the plant. It is a potent signaling molecule in plants and is involved in eliciting responses to biotic and abiotic stress. As a result, both help in early growth and helps to meet the increasing demand of growers in an eco-friendly way.

Acknowledgement. The author conveys their thanks to the staff of Horticulture department Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (Uttar Pradesh) India for their colossal assistance, without which the trial would not have been successful.

Conflict of Interest: As a Corresponding Author, I Vankar Sowgandhika, confirm that none of the others have any conflicts of interest associated with this publication

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How to cite this article: Vankar, S., Kerketta, A. and Bahadur, V. (2021). Effect of Pruning and Foliar Application of Brassinosteroid and Salicylic acid on Growth, Yield and Quality of Phalsa (*Grewia subinaequalis* L.). *Biological Forum – An International Journal*, *13*(3a): 483-486.