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# Alleviation effects of brassinolides on growth and yield of cucumber (*Cucumis sativus* L.)

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## Abstract

An experiment was carried out at PAU, Ludhiana to study the effect of brassinolides (BRs) on the growth and yield of cucumber (cvs. Indam and Punjab Naveen). Plants were sprayed with brassinolides @ 500 ppm twice i.e. first at the time of 25% flowering and second at 15 days interval of after first spray. The observations were recorded on vine length, number of fruits per plant, average fruit weight and fruit yield. BRs promoted the vegetative growth of cucumber plant and increased its vine length by 9.50%. BRs also increased the number of fruits per vine and fruit weight by 13.26% and 2.2% than the non-treated plants. There was significant difference between varieties response to the application of BRs. The mean fruit yield of both the varieties was 12.46% higher than the untreated control.

**Keywords:** Brassinolides, cucumber, vine length, yield

## Introduction

Cucumber (*Cucumis sativus* L.) is an important vegetable crop cultivated on commercial scale during summer season in northern India. It belongs to family cucurbitaceae, and its primary centre of origin is India (Zeven and Deweb 1982). It is an ideal summer crop chiefly grown for its edible tender fruits preferred as salad ingredient, pickles, and dessert fruit and as a cooked vegetable. Its high water content makes it diuretic. Cucumber has a cleansing action within the body by removing accumulated pockets of old waste material and chemical toxins. It also helps in the treatment of arthritis, since it helps in elimination of uric acid. Its low calorie makes it perfect food for diet. Its juice is also nourishing for our skin and hair, has the reputation of being rejuvenator and makes one feel look young. Cucumber also has the power to relax and alleviate the sunburn's pain. Cucumber is a women's friend when they are on a diet but also for its cosmetic properties.

This family is characterized by various forms of sex expression varying from strict gynoecious to hermaphrodite as well as monoecious, which is most common one (Kubicki 1972). Though many varieties and hybrids have been developed in cucumber, the yield potential is low and hence, there is need to improve the yield potential to meet the demand. Although high yielding hybrids do extremely well under normal management practices, very seldom their full genetic potential is realized. Facing with such constraints, application of plant growth regulators (PGRs), for higher yields, is gaining momentum. Brassinolides (molecular formula=$C_{28}H_{48}O_6$) is a naturally occurring plant steroid that promotes growth, increases yields raise the ratio of fruit bearing and increase the fruit weight and makes plants more resistant to drought and cold weather. Brassinolides was first isolated from rapeseed plant pollen (*Brassica napus* L.). Plants treated with brassinolides can produce yields that would be unable to attain by using standard practices (Khripach *et al*. 2000, Divi and Krishna 2009). Brassinolides play prominent roles in various physiological processes including the induction of a broad spectrum of cellular responses, such as stem elongation, pollen tube growth, xylem differentiation, leaf epinasty, root inhibition, induction of ethylene biosynthesis, proton pump activation, regulation of gene expression and photosynthesis, and adaptive responses to environmental stress (Clouse and Sasse 1998, Dhaubhadel *et al*. 1999, Khripach *et al*. 2000 and Krishna 2003). Specific effects on plants by brassinolides includes: promoting shoot elongation and strongly increasing root growth and development. Hence, there is an urgent need to improve the productivity through manipulation of source-sink relationship by using brassinolides. Such substances are therefore potentially useful in agriculture because suitable concentrations applied at appropriate time will increase

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the yield. In view of their wide spectrum effectiveness on every aspect of plant growth, even a modest increase of 10-15 percent could bring about an increment in the gross annual productivity by 10-15 million tons. Considering the importance of consuming nutritive rich vegetables and fruits in the daily diet, it was thought to investigate the influence of brassinolides for enhancing productivity potential in cucumber.

## Material and Methods

An experiment were conducted during summer season of 2012-13 and 2013-14 at vegetable research farm, Punjab Agricultural University, Ludhiana in randomized block design with three replications to study the influence of plant growth regulators on growth and yield in cucumber. In the experiment two cultivars (Indam and Punjab Naveen) were treated with brassinolides @ 500ppm and water along (control). First spray was applied at the time of 25% flowering and second at the interval of 15 days after first spray. All other cultural practices were followed as per recommendations of Punjab Agricultural University, Ludhiana. The data on vine length, number of fruits per plant, average fruit weight and fruit yield were recorded. The vine length was measured 60 days after sowing from the cotyledonary node up to the growing tip and the means were worked from three plants which were selected at random in each treatment and expressed in centimeters. The number of fruits harvested at each picking from the tagged plants was recorded and the total number was calculated summing from all the harvests. The average per plant was then worked out. For average fruit weight, three random fruits were collected from each and their fresh weights were recorded and averaged. The total fruit yield was calculated both on q/acre and kg/plant. It was calculated by multiplying net plot yield per acre by total yield per vine of three randomly labeled plants. The data were statistical analysis according to the procedure of Gomez and Gomez (1984).

## Results and Discussion

**Vine length:** It was evident from the data given in Table 1 that mean vine length was significantly improved with the application of brassinolides (+9.50%) i.e. 141.8 cm as compared to control (129.5 cm). The trend was same in both the varieties and years. The maximum length of 152.8 cm was observed in variety Indam (sprayed) during 2013-14 while minimum (118.5 cm) in Punjab Naveen (control) treatment during 2013-14. There was significant difference between varieties response to the application of brassinoides. There was more increase in vine length of cultivar "Punjab Naveen" (+10.17%) as compared to "Indam" (+8.93%) with application of brassinoides. The promotion of growth either in terms of increase in the vine length has been thought to be by increasing plasticity of the cell wall followed by hydrolysis of starch to sugars which lowers the water potential of cell, resulting in the entry of water into the cell causing elongation. These osmotic driven responses under the influence of brassinolides might have attributed to increase in photosynthetic activity, accelerated translocation and efficiency of utilizing photosynthetic products, thus resulting in increased cell elongation and rapid cell division in the growing portion. These results are in conformity with the findings of Singh and Choudhary (1989) in watermelon and summer squash. The stimulative effect of $GA_3$ at 25 ppm on vine length was also noticed in watermelon by Arora *et al*. (1985). A similar increase in vine length in cucumber was also observed by Vadigeri *et al.* (2001).

**Number of fruits:** The number of fruits per plant was significantly higher with the foliar application of Brassinolides @ 500 ppm. It was evident from the data given in Table 1 that mean number of fruits per plant was significantly increased with the application of brassinolides (+13.26%) i.e. 7.7 cm as compared to control (6.8 cm). The increase in fruit number per plant was observed in both varieties and in both years. There was significant difference between varieties response to the application of brassinoides. There was more increase in number of fruits of cultivar "Punjab Naveen" (+14.55%) as compared to "Indam" (+12.35%) with application of brassinoides. The maximum number of fruits per plant was observed in variety Indam (sprayed) during 2012-13 and 2013-14 (9.1) while minimum (5.4) in Punjab Naveen (control) during 2012-13. The higher number of fruits per plant was obtained as a result of more female flowers per plant and better vegetative growth (Sidhu *et al.* 1982). Similar results were also reported by Dostigir *et al.* (2006) in bittergourd. An increase in number of fruits per plant in treated plants may further be attributed to the reason that plants remain physiologically more active to build up sufficient source for the developing flowers, ultimately leading to more number of fruits.

**Average fruit weight (g):** The data presented in Table 1 indicated a fresh fruit weight differed significantly due to foliar application of Brassinolides. Among varieties and years, the maximum (265.5 g) average fruit weight was observed in variety Punjab Naveen (sprayed) during 2012-13 while minimum (229.6 g) in variety Indam (control) during 2013-14. There was non-significant difference between varieties performance w.r.t the application of brassinoides. The percent increase in fruit weight was more in variety "Indam" (+2.3%) as

**Table 1:** Effect of Brassinolides on growth and yield of cucumber

| Observation | 2012-13 | | | | 2013-14 | | | | Mean of both years | | | | Mean of both varieties | | C.D (P=0.05) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Punjab Naveen | | Indam | | Punjab Naveen | | Indam | | Punjab Naveen | | Indam | | | | |
| | Spray | Control | Spray | Control | Spray | Control | Spray | Control | Spray | Control | Spray | Control | Spray | Control | |
| Vine length (cm) | 138.5 | 121.5 | 149.8 | 138.4 | 125.9 | 118.5 | 152.8 | 139.4 | 132.2 | 120.0 | 151.3 | 138.9 | 141.8 | 129.5 | 10.4 |
| Number of fruits/plant | 6.5 | 5.4 | 9.1 | 7.9 | 6.1 | 5.6 | 9.1 | 8.2 | 6.3 | 5.5 | 9.1 | 8.1 | 7.7 | 6.8 | 0.8 |
| Average fruit weight (g) | 265.5 | 260.5 | 245.4 | 235.6 | 250.9 | 245.5 | 230.4 | 229.6 | 258.2 | 253.0 | 237.9 | 232.6 | 248.1 | 242.8 | 18.4 |
| Fruit yield (q/acre) | 74.5 | 65.4 | 83.4 | 74.6 | 66.5 | 60.6 | 85.7 | 75.2 | 70.5 | 63.0 | 84.6 | 74.9 | 77.6 | 69.0 | 4.1 |

compared to variety "Punjab Naveen" (+2.1%) with application of brassinoides. The increase in fresh weight is probably due to accumulation of large amount of water and sugars in fruit pulp. A similar increase in fruit weight in cucumber was also observed by Vasantkumar and Sreekumar (1981).

**Fruit yield:** Yield is a complex character which involves the interaction of several intrinsic and external factors. It largely depends upon the production and mobilization of carbohydrates, uptake of nutrients and water from the soil and the hormonal balance, in addition to several environmental factors to which plant is exposed during the growing period (Schaffer and Andersen 1994). In addition, cucumber yield depends not only on the accumulation of photo assimilates during the crop growth and development, but also on its partitioning in the desired storage organs (Jiang *et al.* 2012). The yield in cucumber was found to be strongly influenced by the application of brassinolides, thus indicating the importance of brassinolides in increasing the yield potential through their effect on various morpho-physiological and biochemical traits. It was evident from the data given in Table 1 that mean fruit yield was significantly improved with the foliar application of brassinolides (+12.46 %) i.e. 77.6 q/acre as compared to control (69.0 q/acre). The trend was same in both the varieties and years. The maximum fruit yield of 85.7 q/acre was observed in variety Indam (sprayed) during 2013-14 while minimum (60.6 q/acre) in variety Punjab Naveen (control) treatment during 2013-14. There was significant difference between varieties response to the application of brassinoides. There was more increase in fruit yield of cultivar "Indam" (+12.95%) as compared to "Punjab Naveen" (+11.91%) with application of brassinoides. This could be attributed to the stimulatory effect of brassinoides on cell division and cell elongation. From the findings it is evident that there is increase in vine length and number of fruits per plant thereby providing more sources for the better development of sinks. The fruit yield in cucumber is expressed in terms of fresh weight since, the edible portion of fruit pulp contains large amount of water and sugars. An increase in fruit yield in treated plants may further be attributed to the reason that plants remain physiologically more active to build up sufficient source for the developing flowers and fruits, ultimately leading to higher yield. The increase in fruit yield by brassinoides is probably due to an increase in carbohydrate metabolism and accumulation of carbohydrates (Mishra *et al.* 1972) as well as auxin directed mobilization of metabolites from source to sink (Weaver 1973; Vasantkumar and Sreekumar 1981).

## सारांश

खीरा की प्रजाति इन्डाम तथा पंजाब नवीन वृद्धि एवं उपज पर ब्रासीनोलीड्स (बी आर एस) के प्रभाव को ज्ञात करने के लिये पंजाब कृषि विश्वविद्यालय, लुधियाना (पंजाब) एक प्रयोग किया गया। पौधों पर ब्रासीनोलीड्स की 500 पी पी एम को दो अवस्था– पहली बार 25 प्रतिशत पुष्पन के समय तथा दुसरी बार प्रथम छिड़काव के 15 दिन के अन्तराल पर किया गया। तना की लम्बाई, प्रति पौध फलों संख्या, औसत फल भार एवं फल उपज का अवलोकन दर्ज किया गया। बी आर एस से खीरे में वृद्धि देखी गयी तथा लता की लम्बाई 9.50 प्रतिशत बढ़ गयी। बी आर एस फलों की संख्या प्रति पौध व फल भार में भी 13.26 प्रतिशत तथा 2.2 प्रतिशत वृद्धि अशोधित पौध की तुलना में पाया गया। प्रजातियों के अन्तर्गत बी आर एस के छिड़काव से सार्थक विभिन्नता पायी गयी। दोनों प्रजातियों में अशोधित नियंत्रक की तुलना में 12.46 प्रतिशत औसतन अधिक उपज प्राप्त हुई।

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