Growth, Productivity and Pod Quality Responses of Green Bean Plants *Phaseolus vulgaris* to Foliar Application of Nutrients and Pollen Extracts

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**Abstract:** Two field experiments were carried out during the two winter growing seasons of 2007 and 2008 aiming to improve growth, production and pod quality of green bean (*Phaseolus vulgaris*, L) cv. Pulista using “Milagrow”, a foliar fertilizer containing phosphorus (20%), potassium (10%), boron (3%) and natural substance extracted from pollen of cabbage. Five levels of application namely 0.0 (control), 3.0, 4.0, 5.0 and 6.0 g/100L were sprayed twice during the growing seasons in two and four weeks after planting. Data analysis showed that all sprayed concentrations improved plant growth i.e plant height, number of leaves, and fresh and dry weights of the plant. Pod yield as well as pod quality parameters were also improved as the concentrations of sprayed materials increased. The improvement in plant growth and production were positively correlated, with the highest response recorded with the concentration 5.0 g/100L after which the response started to decline but still significantly higher than control treatment. Mineral contents of N, P and K in the plant showed also similar trend to the applied concentrations. It could be concluded that the application of extracted natural materials such as pollen extracts of cabbage in combination with P, K and B in concentration of 5.0 g/100L gave the best improvement in plant growth and production.

**Key words:** Green bean, *Phaseolus vulgaris*, pod production, pod quality, mineral content, pollen extracts.

**INTRODUCTION**

The Egyptian horticultural sector is rapidly becoming oriented towards the international market. Egypt has the potential to increase its export levels and the success will lie in meeting the quality standards of the EU markets [1]. The potential of Egyptian bean production exported to EU market is too high however; it has to compete with other producers. This competition will be in favor of the one who can produce and supply the consumer demands with a guaranteed quality level with which they can maximize the market windows with a quality product. High pod production may be brought about by higher plant growth associated with enhanced pod set. Enhancing plant growth and production of green bean was achieved by many techniques such as improving fertilization regimes [2] and irrigation [3]. However, higher plant growth may not be totally interpreted in the form of yield. Overdose fertilizers may result in bigger shoot growth and not economic pod yield. Therefore enhancement of pod set is thought to be a proper technique along with previously recommended fertilization regimes. Enhancement of pod set in green beans has been correlated with hormonal balance [4]. However, a lot of restrictions exist concerning the application of synthetic plant growth regulators particularly on export-oriented crop production. On the other hand, natural products containing some promoting hormonal substances such as pollen extracts started to be in the market. No literatures until now were found advising of no application of natural substance on growing crops. To the contrary, extracts of some natural substances were reported to improve plant growth, production and quality in one way or another [5, 6].

The importance of green bean crop comes also from its high nutritional values that may balance the nutrition in human meals in many parts of the world. The biochemical and nutritional attributes of grain legumes, including *Phaseolus vulgaris* are reviewed by Norton et al. [7].

Therefore, the aim of this study is to investigate the effect of foliar application of pollen extracts associated with some nutrients on the growth, production and quality of green bean plants.

**MATERIAL AND METHODS**

Two field experiments were carried out during the two successive winter seasons of 2007 and 2008 in a private farm in New Salhaia region, Sharkia governorate to investigate the effects of different foliar application rates of “Milagrow”, a pollen extract of...
cabbage mixed with P, K and B on the growth and yield of green bean plants (*Phaseolus vulgaris, L.*) cv. Pulista under the new reclaimed land conditions.

The experiment included five levels of foliar spraying of “Milagrow™”, a natural extract from pollen of cabbage which contain plant growth promoters such as auxin, cytokinin and gibberline as well as phosphorus (20%), K (10%) and B (3%). The applied treatments of Milagrow were 0 (control), 3, 4, 5 and 6 g/100liter. Spraying was carried out until enough runoff was observed. The treatments were applied twice during the growing seasons after two and four weeks after planting.

During soil preparation, organic and inorganic fertilizers were added in the rate recommended by the ministry of agriculture in the area. Drip irrigation was used where one irrigation cycle was given 48 hours before seed sowing. Irrigation was then carried out when needed to the end of the season.

Seeds of snap bean variety were sown on the first week of November in the two seasons in 5 cm deep halls on both sides of the row at 7 cm apart. Each row was covered with low tunnel that consisted of semi-cylindrical profile made of galvanized wire no. 8, 60 cm height covered with 60-micron clear polyethylene film. Agricultural practices other than the experimental treatments were carried out as recommended by the Ministry of Agriculture in Egypt.

**Data Recorded:**

**A - Plant Growth:** random samples of five plants were taken at 45 days after sowing from each plot to measure plant growth parameters i.e. plant height, number of leaves as well as fresh and dry weights of plant.

**B – Green Pods Yield:** Pickings were carried out to harvest green pods that reached its marketing stage (as ton / fed). Total of 4 pickings were carried out.

**C - Pod Quality:** At the second picking, a random sample of 100 pods from each experimental unit was used to measure pod length (cm), and diameter (mm). Chemical analysis of bean leaves was carried out after harvest to determine mineral contents (N, P, and K). The plant materials were dried in an oven at 70 °C until a constant mass was reached and then they were grounded for chemical analysis. Total nitrogen was determined using the micro-Kjeldahl method [8]. P was determined spectrophotometrically according to Troug and Meyer [9]. K content was determined using an atomic adsorption spectrophotometer [10]. Total fiber contents in the pods were determined according to Rai, and Mndgal [11].

Randomized Complete Block design with three replicates was followed. The obtained data were statistically analyzed by the method described by Gomez and Gomez [12].

**RESULTS AND DISCUSSION**

**Vegetative Growth:** Data in Figure (1) illustrate the measured growth parameters of green bean plants as affected by the applied concentrations of Milagrow. Plant height and number of leaves responded positively to the increment in the applied concentration with the maximum response recorded with the concentration of 5g after which the response started to decline. Despite this decline, all applied concentrations were significantly higher than control treatment. There were no significant differences under both concentrations of 3 and 6g applications regarding these two parameters. The same previous trend was observed regarding the fresh and dry weights of the shoots where all applied treatments gave positive effect on both parameters compared to control treatment. This positive effect was increased as the applied concentration increased until 5g after which the effect started to decline.

**Yield and Pod Quality:** Number of pods per plant as shown in Figure (2) was increased as the applied concentration increased until 5g after which the number of pods started to decrease however was still significantly higher than control. Average weight of individual pods (Figure 2) showed the same observed trend where all applied concentrations gave a gradual positive effect until 5g concentration was reached after which the effect started to decline but still significantly higher than control. There was no significant effect between the two concentrations of 4 and 6 g regarding this parameter. Pod diameter and pod length responded also positively to the applied concentrations (fig. 2). There was no significant difference between control treatment and concentration of 3g regarding pod diameter. Percentage of fiber contents in the pods was the only parameter that showed a negative response to the applied concentrations. The gradual negative response continued until 5g was reached and after which the trend was reversed at 6g application. There was no significant difference in fiber contents at applied concentrations of 4 and 6 g.

**Mineral Contents:** Mineral contents as shown in Figure (3) showed the same trends observed in the growth parameters where all applied concentrations had positive gradual effect as the applied concentration increased. Only potassium content showed no significant differences among most of the treatments except with the concentration of 5g however, effects of all applied concentrations were significantly higher than control.
Fig. 1: Vegetative growth parameters of green bean as affected by applied concentrations of Milagrow. Left and right columns are data of 2007 and 2008 seasons respectively.
Fig. 2: Yield parameters of green bean as affected by applied concentrations of Milagrow. Left and right columns are data of 2007 and 2008 seasons respectively.
Discussion: Irrespective of whether agricultural products are grown for the domestic market or for export, the quality of the produce determines success in the market. The complementary fertilization through foliar application has been widely used in order to improve product quality and to overcome some soil problems related to ground fertilization. In this study, foliar application aimed at not only improving plant growth per se, but also improving the economic yield in terms of quantity and quality. The presence of natural plant hormones in the foliar application in the pollen extracts improved pod set which appeared in the increment in number of pods per plant. The presence of pollen extracts in the foliar application means spraying growth promoters such as auxins, gibberelins and cytokinins. All of these promoters work in one
way or another in improving plant growth and production through improving its biological process. Ofir et al. found a strong relation between pod sets and seed formation in green bean and the level of auxin (IAA) in the flower or pods. Moreover, supply of nutrients plays an important role in growth and yield of plants. The effect of P, K and B in the foliar application cannot be ignored. Increment in bean yield was reported as the fertilization of P increased as reported by Roy and Parthasarathy who found that pod yield was the highest with 120 kg P compared to lower rates. Generally, increasing NPK rates or increasing N:P fertilizer levels only, increased yield of green bean compared to lower rates. Phosphorus fertilization contributes to early crop development and maturity, whereas potassium influences both yield and pod quality. In this study, increasing PK levels resulted in increment in vegetative growth particularly number of leaves which might result in higher leaf area hence, higher assimilate production which reflected on yield. This explanation agrees also with other findings where it was concluded that the amount of photosynthate available for biomass production is related to the current leaf area and the photosynthetic rate of the crop in consideration. Moreover, B plays an important role in the formation and function of plant reproductive organs specially pollen tube growth. This contributes more in higher pod set which was observed in the form of higher pod number per plant. It follows that foliar application of Milagrow improved plant growth and production of green bean by supplying the plant with extra dose of necessary nutrients and hormones.

The quality of green bean expressed as fiber contents was enhanced with increasing concentration of foliar application. This can be explained on the basis of the above explanation where increasing plant growth promoters and nutrients reduce fiber contents in addition to increasing assimilate production which means higher carbohydrates going to the pods and less stress on the growing pods. This is supported by Marschner who reported that potassium has a crucial role in the translocation and storage of assimilates.

It could be concluded that foliar application of extracts of cabbage pollen mixed with some nutrients such as P, K and B can promote plant growth and production as well as pod quality of green bean plants.

REFERENCES


