The integrated effect between phosphorus fertilizing levels and biological control on damping - off, root rot diseases and its reflection on an improving growth and fresh pods yield of priming and non-priming pea seeds

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ABSTRACT

Two experiments were conducted in newly reclaimed soil for two successive winter seasons during 2014/2015 and 2015/2016 at El-Nobaria region, Beheira, Egypt on two peas cultivars, i. e. Little Marvel (LM) and Master B (MB). The purpose of this study is to improve the efficiency of biological seed treatments such as bio-priming and seed coating with *T. harzianum* in control of root rot disease and improve vegetative growth of pea plants under field conditions. In this investigation four levels of phosphorus were used, i.e. 0, 25, 50 and 75 kg P_2O_5 per fed. and combined with four biological seed treatments, i.e. untreated seeds (control); treated seeds with bio-priming, priming and coated by *T. harzianum*. Pea root rot disease incidence was recorded after 30 and 60 days of sowing. Results showed that the highest vegetative growth characters, total green pods yield and good quality were obtained by plants of Master P (MB) cultivar compared to Little Marvel (LM). The highest values of previous characters were recorded by plants which received 50 kg P_2O_5 / fed compared with other levels. Phosphorus fertilizer levels at 50 and 75 units/ fed were highly effective then 25 units/ feddan in decreasing the root rot % infection and reduction in the incidence of root rot of pea plants. Recommend by using pea seeds of cv. Master B in cultivation and using bio-primed seeds with bio-control agents like *T. harzianum* or *T. viride* or *T. asperellum* should be utilized for managing seed borne pathogens and fertilizing pea plants by adding mineral phosphorus fertilizer.

Keywords: Bio-priming; Damping off; Fresh pods yield; *Fusarium solani*; *Rhizoctonia solani*; Root rot Pea.

INTRODUCATION

Pea (*Pisum sativum* L.) is one of the most important leguminous crops for exportation and local consumption in Egypt. Seeds of pea are used a fresh and dry for cooking and industries. It is a crop cultivated in scattered areas for exportation so, it became of great importance to study its cultivars, fertilization and diseases. Growing pea in the newly reclaimed soils is faced by various problems, such as root rot disease in many locations and low amounts of available nutrients. Pea plants proved vulnerable to root diseases caused by certain soil borne fungi, i. e. *Fusarium solani*, *Rhizoctoni solani*, *F. oxysporum*, *Pythium spp*, *Sclerotium rolfsii* and *Phytophthora cactorum* which attack roots causing damping off and root rot diseases as well as substantial losses in yield of pea (Abda *et al*., 1992; Persson *et al*., 1997; Ragab *et al*., 1999; Xue, 2003).

The function of phosphorus in plants is very important. It helps a plant convert other nutrient into usable building blocks with which to grow. Phosphorus is one of the main three nutrients most commonly found in fertilizers and is the "P" in the NPK balance that is listed of fertilizers (Lovatt and Mikkelsen, 2006).

Srivastava *et al*. (1998) stated that the high requirement for (P) in legumes is consistent with the involvement of P in the high rates of energy transfer that must take place in the nodule. In addition, phosphorus has an enhancing impact on plant growth and biological yield through its importance as energy storage and transferee necessary for metabolic processes.

Togay *et al*., (2008) pointed that the highest growth parameters of lentil plants were obtained from 60 Kg P ha^{-1}.

Agegnehu (2009) found that application of phosphate fertilizer at the rates of 10, 20 and 30 kg P ha^{-1} increased mean grain yield of field pea by 36, 67 and 57%, respectively compared to the control. Many investigators studied the role of phosphorus in fertilizing pea plants (Gubbels, 1992; Karamanos *et al*., 2002; Malakooti and Nafisi, 1995; Murat *et al*., 2009 and Nadeem *et al*., 2003; Manore and Altaye 2018).

Few studies examined the possible utilization of some agricultural practices such as fertilization or soil amended with chelating elements (calcium and sulphur) in control of soil borne plant pathogens on several plants. Graham, 1983 found that moderate phosphorus levels tend to decrease disease incidence in particular fungal diseases such as pythium root rot whereas, very high or low levels tend to increase disease incidence.

Priming of seeds is a well-established technology to improve speed and uniformity of germination. Seed priming is an age old practice exercised by Greek. They resoaking of cucumber seeds in milk or water to make then germinate earlier and Vigorously (Evanari, 1984). The term "seed priming" was proposed by Heydecker *et al*. (1973) for the soaking drying seed treatments. This technique is a treatment applied prior o sowing in a specific environment where in seeds are partially hydrated in pure water or osmatic solution for a predetermined time interval, to a point of germination process initiation without visible symptom of radical emergency (Kaur, 2002) and (Giri and Schilinger, 2003). Seed priming involves taking seed through the early stages of the germination process. Diring the phase I, under moderate temperature and moisture, seed takes up water. During phase II, the biochemical processes are activated in order to allow the necessary germination related metabolic acclivities to take place, but radical emergence is prevented by limiting the seed water content (Bradford, 1986). The seeds were tacked part way through phase II and then dried before the root can emerge from the seed. The need for drying to facilitate the handling, storage and sowing of seeds (Demir, 2003). Once conditions are appropriate in field, phase III can continue, germination occurs in a much shorter time.

Olant seeds can be subjected to different priming treatments such as polyethylene glycol or sorbitol (Osmo-priming), abscisic acid (Hormonal-priming) and Calcium or sodium chloride (Holo-priming) etc. (Kalpanan *et al*., 2015).

When dry seeds are treated with a bio-control agent, they called (Seed coating treatment) while when primed seeds are treated with the bio-control agent, they called (Seed bio-priming). In solid matrix priming, seeds are mixed with a solid material and water. This soild material should be had a water-holing capacity such as a ground Leonardite shale or Carboxy methyle cellulose (CMC) (Taylor *et al*., 1988).

Controlling root disease mainly depends on fungicidal treatments. Meanwhile, fungicidal applications cause hazards to human health and increase environmental pollution. Therefore, there are needed to alternative fungicidal seed treatment. The application of biological seed treatments alone or in combination with other disease control approaches such as fungicides, physiological process and soil amendments and priming proved to be successful for controlling various plant diseases on many crops.

Biological control is proposed to be an effective and non-hazardous strategy to reduce crop damage caused by plant pathogens. Application of biological control using antagonistic microorganisms against seed and root rot pathogens proved to be successfully and its efficiency in controlling root rot pathogens and improving plant growth, total yield and nutritional values of many vegetable crops (El-Mohamedy *et al*, 2014). Coating seeds of many crops with bio control agents such *Trichoderma spp*., *Bacillus subtillus*, *Psedomonas fluorescens* was the most effective treatments for controlling seed and root pathogens (Nayaka *et al*., 2008; Begum *et al*., 2011).

Pea seeds coated with *Trichoderma koningii* and *T. viride* were the most effective treatments for controlling pea root rot pathogens (Lacicawa and Pjeta, 1994; Benhamou *et al*., 1996; Ragab *et al*., 1999; Rauf, 2000; Xue, 2003). *Trichoderma spp*. is widely used as bio-control agent that enhances plant growth as well as inhibits phytopathogens (Vivek *et al*., 2016).

Seed bio priming is an advance technique of seed treatment that involves application of beneficial microorganisms on seed surface followed by seed hydration. Seed bio-priming is an ecological management strategy to control many seed and soil-borne pathogens which provide an alternative to chemical treatment. Seed bio-priming enhance the initial step of plant development by increased seed germination and provide protection before seedling emergence.

Recently, bio-priming as biological seed treatment that integrate biological and physiological aspects of disease control was used alone or in combination with soil amendments as alternative methods for controlling many seed and soil borne pathogens (Harman and Taylor, 1988; Warren and Bennett, 1999; El-Mohamedy, 2004; El-Mohamedy *et al*., 2006; El-abd *et al*., 2013; El-Mohamedy and Abd-Alla, 2013 and Vivek *et al*., 2016).

The combination between seed coating with bio control agents and chitosan were the most effective for controlling pea root rot disease and increasing growth and yield of pea plant (Abd El-Kareem, 2002). Ragab *et al*., 1999 noticed that combination between fungicides (Rizolex-T or Topsin-M) and *Bacillus subtillis* gave the best significant reduction in pea root rot disease caused by *Rhizoctoni solani*, *Phytophthora spp.* and *Fusarium solani*.

The purpose of the present study is to improve the efficiency of biological seed treatments such as bio-priming and seed coating with *T. harzianum* in control of root rot disease and improve vegetative growth of pea plants under field conditions.

MATERIALS AND METHODS

Two drip irrigated field experiments were carried out on pea (*Pisum sativum* L.), Fam. Leguminous in an area of newly reclaimed land the experimental farm of National Research Centre, at El-Nobaria, Beheria Governorate, Egypt, during the two successive winter seasons of 2014/2015 and 2015/2016.

The aim of this work was evaluation of two pea cultivars under open field conditions and levels of phosphorus fertilizer to resistance root rot and damping off diseases. Random soil samples were collected before planting from the top layer (0-30 cm depth) for physical and chemical analysis. Soil analysis and the main analytical data of the soil are presented in Table (1), following the procedures of Page *et al*. (1982) and Klute (1986). On the other hand, organic manure (compost) contents of total and available N, P and K and some micro-elements were presented in Table (2) following the procedures of Page *et al*., (1982).

The soil of the experimental plots was carefully prepared, in each growing season. Ditches of 20 cm depth and 40 cm width were prepared in the sites of drip irrigation lines; calcium super phosphate and organic manure [compost at rat of 60 N units per fed.] were mixed and added in the ditches then covered by soil. Ammonium sulfate (20.6 % N) was used as a source of nitrogen, calcium super phosphate (15.5 % P_2O_5) as a source of phosphorus at the rate of 0, 25, 50 and 75 P_2O_5 unit/fed and potassium sulphate (48 % K_2O) was used as a source of potassium at the rate of 50 K_2O unit/fed. The quantities of the mineral fertilizer were splinted into three equal doses and applied as dressing (30, 60 and 90 days after sowing) beside plants. Drip irrigation lines were spread over the ditches. Soil was irrigated continuously three days before sowing. Seeds were sown on the two sides of each row 75 cm in width and 50 cm apart. Each plot included three rows, plot area was 10.5 m^2. Seeds were sown in the open field on the first week of December in the two seasons of 2014/2015 and 2015/2016.

The causal pathogens:

Samples of pea seedlings and plants showing damping-off and root rot disease symptoms were collected from different pea field of NRC farm were subjected to isolation trails of the causal organisms. The purified isolated fungi were grown on PDA media and identified according to cultural and microscopic characters as described by Gilman (1957), Barrent and Hunter (1972), Nelson *et al*. (1983). The pathogenic ability of isolated fungi to induce damping off and root rot infection of pea plants was tested.

Table 1. Physical and chemical properties of the experimental soil during the two seasons of 2014/2015 and 2015/2016.

A. Physical properties

Season	Sand (%)	Clay (%)	Silt (%)	Soil texture
2014/2015	91.20	5.10	3.70	Sandy
2015/2016	92.33	4.78	2.95	Sandy

B. Chemical properties

Season	E.C. (mmohs/cm^3)	pH	OM (%)	CaCo$_3$ (%)	Cations (Meq./L)				Anions (Meq./L)			
					Ca^{++}	Mg^{++}	Na^+	K^+	CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}
2014/2015	0.30	7.80	0.30	10.2	1.00	0.20	0.80	0.39	Nil	1.00	1.00	0.39
2015/2016	0.50	7.88	0.50	10.8	1.20	0.26	0.82	0.43	Nil	1.10	1.20	0.41

Table 2. Chemical analysis of compost manure used in 2014/2015 and 2015/2016.

Mineral content	(2014/2015)	(2015/2016)
N %	2.20	2.46
P %	0.91	1.80
K %	1.40	2.37
C/N ratio	4.29	7.40
D.M %	28.1	46.5
O.C %	16.3	27.00
Cd ppm	1.10	0.90
F ppm	0.89	0.92
Humidity	17.20	17.48

Field experiment

These experiments were carried out under open field conditions. The farm land has been known as heavily natural contaminated with root rot pathogens. Treatments were conducted in split – split plots design with three replicates.

Treatments of the experiment were as follows

a) Cultivars: Two cultivars of pea, i.e. Little Marvel (LM) and Master B (MB).

b) Phosphorus levels: Four levels of phosphorus fertilizer, i.e. 0, 25, 50 and 75 P_2O_5 unit/feddan were applied individually or in combination with seed treatments. Calcium super phosphate (15.5 % P_2O_5) as a source of phosphorus was applied.

c) Biological seed treatments: Four seed treatments were as follow: 1. Non treated seeds (control), 2. Bio-primed seeds. 3. Primed seeds. 4. Seeds coated with *T. harzianum*.

Seed Priming and bio-priming: Seeds of two cultivars, i.e. Little Marvel (LM) and Master B (MB) were initially washed with tap water to remove microbial load. Seeds were primed according to methods described by Osborn and Scharoth (1989) and Harman and Taylor (1988) by soaking in 1% Carboxy methyl cellulose (CMC) in Erlenmeyer flask on a rotary shaker set at 150 rpm for 4 hrs.

Seed bio-priming with *Trichoderma harzianum*: Seeds of pea were surface sterilized with 1.5 % sodium hypochlorite (NaOCl) for 5 minutes and rinsed thrice with autoclaved distilled water and dried under laminar air flow on autoclaved blotting paper (Jain *et al*., 2012). CMC 1% supplemented with spore suspension of *T. harzianum* ($3x10^6$ spore /ml) were subsequently added to seed during priming process for 30 minutes to bio-primed seeds. Primed and bio-primed seeds were shaken at 150 rpm for 12 hour, then dried and placed in polyethylene bags for further studies.

Seeds treated with CMC only acted as control. The seeds were dried in laminar air flow for 2 h (Singh *et al*., 2013a). The seeds were placed in the moist chamber at 98 % relative humidity and 28 – 30°C, and maintained for 24 h (Jensen *et al*., 2004).

Seed coating: Pea seeds were immersed for 30 min. in a suspension of *Trichoderma harzianum*. This bio control agent was previously isolated from a rhizosphere soil of healthy pea plants and antagonistic ability against some root rot pathogens was recorded. Spore suspension of *T. harzianum* was prepared from 7- day old cultures grown in PDA medium. Fungal spores were gently scraped from PDA cultures in water and filtered through nylon mesh (38 Mm). All spores solution were adjusted with sterile water to density concentration of $1x10^6$ cfu/ ml. Seeds were coated by shaking 1 g of seeds per treatment with 4 ml of the adjusted conidial suspension on a shaker (1 KA vibrax, 1 KA works, Wilmington No. l for 10 min. at 130 rpm. Subsequently, the seeds were air-dried on filter paper for 1 h in a laminar flow hood before planting (Nayaka *et al*., 2008).

Experimental design: Each replicate included 32 treatments which were the combinations of two cultivars of pea and four levels of phosphorus fertilizer treatments with four seed treatments. The split-split plots design with three replicates was used. The main plots were cultivar treatments, whereas, the sub plots were assigned for the phosphorus levels and biological seed treatments were placed in the sub-sub plots. Data were subjected to proper statistical analysis according to Snedecor and Cochran, 1980.

Data recording

Biological data

The percentage of plot stand, i. e. the number of plants which had emerged as a percentage of those that were originally planted was determined 14 days after planting, and then the percentage of dead or damped seedlings was calculated (Hwang *et al*., 1996). The pea root-rot incidence percentage was determined 30-60 days after planting. Sample plants pulled out along a diagonal transect across the field, five plants per site and 100 plants per field. Root-rot incidence percentage was scored using the following formula: No. of diseased plants/ No. of plants observed x 100 (Kobriger and Hagedorn, 1983). The percentage of survival plants in each particular treatment was calculated. Moreover, the beneficial effects of the different treatments on vegetative growth of the two cultivars of pea plants were investigated.

Vegetative growth characteristics

Random samples of five plants from all treatment were harvested at maturing stage and the following data were recorded during the two seasons.

1. Plant length (cm).
2. Leaves number per plant.
3. Branches numbers/ plant.
4. Fresh weight of leaves, stems, pods and seeds (g/ plant).
5. Dry weight of leaves, stems, pods and seeds (g/ plant).

Total fresh pods yield

All the plants every treatment was harvested at maturing stage and the following data were recorded, i. e. total green yield (ton/fed.).

RESULTS AND DISCUSSION

Effect of cultivars (Classification reactions)

Damping-off and root rot incidence

Pea root rot disease incidence was recorded after 30 and 60 days of sowing. Results in Table (3) show that pea of cv. Master B (MB) reduced the incidence of root rot until 60 days compared with cv. Little Marvel (LM) during two seasons**.** MB cultivar was highly effective in decreasing the percentage of root rot infection. The highly percentages of survival plants were recorded with of MB cultivar compared with LM cultivar which records the low survival percentage. These results are in accordance with those observed by El-Mohamedy and Abd–El-Baky, (2008).

Vegetative growth and total pods yield

The results indicated that statistical variations were recorded in the vegetative growth of the tested two pea cultivars (Table, 4). The results indicated that MB cultivar was the best in its vegetative growth, i.e. leaves number; fresh weight of leaves, pods and seeds and dry weight of leaves, pods and seeds as well as total fresh pods yield (ton/fed) compared with LM cultivar. Plant length, branches number and stems fresh weight characters were not significant. The lower values of vegetative growth were recorded by LM cultivar.

These results were similar and true in the two seasons. Similar results were reported on pea by many investigators (Badr *et al*., 2015) on pea indicated that cv. Master B showed higher values for most of the growth traits and yield parameters in comparison with cv. Little Marvel. The hybrids of cv. Master B significantly surpassed the highest parental genotypes for days to flowering and fruiting and also productivity.

Effect of phosphorus fertilizer levels

Damping-off and root rot incidence

Data presented in Table (5) clear that pea root rot disease incidence was recorded after 30 and 60 days of sowing. Results show that all phosphorus levels reduced the incidence of root rot until 60 days on pea plants during two seasons. Phosphorus fertilizer levels at 50 and 75 P_2O_5/ feddan were highly effective then 25 units/ feddan in decreasing the percentage of root rot infection of pea plants during two seasons. The treatment of 75 P_2O_5 reduced the incidence of pea root rot by 26.88, 31.80 % and 25.24, 31.25% in pea plants compared with 0 unit/ feddan (control) after 30 and 60 days after sowing date during two seasons, respectively. Meanwhile, the treatment of 75 P_2O_5/ feddan cause a reduction in the incidence of pea root rot estimated by 34.91 %, 40.03 % and 32.35 %, 39.61 % on pea compared with control after 30 and 60 days of sowing during two seasons, respectively. The highly percentages of survival pea plants were recorded with 50 and 75 P_2O_5 unit treatments. Many investigators reported that, increasing phosphorus rates above the level needed to grow the crop can increase the severity of Fusarium wilt in muskmelon (Jones *et al*., 1989).

Vegetative growth and total fresh pods yield

Data presented in Table (6) show that the effect of phosphorus levels on vegetative growth characters and total fresh pods yield of pea plants expressed as plant length, leaves and branches number/ plant, as well as fresh and dry weight of leaves, stems, pods and seeds and total fresh pods yield (ton/fed). The results revealed that vegetative growth of pea plants was enhanced by increasing phosphorus fertilizer rates up to 50 kg P_2O_5/ feddan. Moreover, the highest values of vegetative growth characters were obtained from application of mineral phosphorus fertilizer at the rate of 50 kg P_2O_5/ fed compared with other phosphors rates treatments in both seasons. Similar results with phosphorus application have been reported by Parasad *et al*. (1989); Sharma *et al*. (1997); Verma *et al.* (1997) and Dass *et al*. (2005). These results were in agreement with those Dass *et al*. (2005) reported that increasing phosphorus levels from 0 to 75 kg P_2O_5 /ha significantly improved the growth, yield and net returns of the crop. Application of 75 kg P_2O_5 /ha resulted in the highest green pod yield of 43.33 q /ha.

Phosphorus is an important nutrient that is essential for plant growth and development which is generally present in unavailable form. Many microorganisms including *Trichoderma spp*. produce organic acids and phosphatase that solubilize the unavailable phosphate to available phosphate that can be easily absorbed by plants. *Trichoderma* spp. also helps to increase the nitrogen use efficiency in plants (Rakshit *et al*. 2015).

Effect of seed treatments

Damping-off and root rot incidence

Percentages of damping-off and root rot infection after 30 and 60 day from sowing were recorded. Results in Table (7) indicated that all seed treatments reduced the percentage of pre-emergence damping-off in pea plants as compared with control (non-treated seeds). The most effective type of seed treatment is bio-priming flowed by seed coating treatment. Bio-priming caused reduction of root rot disease incidence reach to 81.24 and 73.71 at pre emergence stage during two seasons, respectively and 71.46, 72.09 % and 75.78, 75.03 % of pea plants at post emergence stage after 30 and 60 days after sowing date during two seasons, respectively. As bio-priming and seed coating treatments caused a reduction of root rot disease by 71.46, 55.86 % and 75.78, 57.99 % of pea plants during the first season, respectively and 72.09, 52.71 % and 75.03, 49.83% of pea plants during the second season, respectively.

These results are in accordance with those observed by Tu, 1992; Persson *et al*., 1997; El-Mohamedy and Abd–El-Baky, 2008 and Vivek *et al*., (2016) on peas. El-Mohamedy and Abd-El-Baky (2008) evaluated the effect of different types of seed treatments on control of root rot disease and reported that seed priming with *Trichoderma harzianum, Bacilus subtilis* and *Psedomonas fluorescens* was effective in control of root rot pathogens and highest percent of reduction of disease in green house. Under field condition bio-priming treatment strongly reduced pea root rot (67.8-84.5%) as against 43.2-61.4% reduction by fungicide treatment (Rizulex-T).

These results are similar to those reported by Lacicowa and Pjeta, 1994 and Xue, 2003, who used bio-priming as a technique of seed treatment to control many seed and soil-borne plant pathogens. Suppression of seed and soil-borne pathogens of bio primed seed is related to the rate of reduction of the incidence of the seed colonization by the pathogens due to reduces seed exudation of nutrients from primed seeds, thus overcoming chilling injures (Khan, 1992); reducing the germination (We, 2000); bio agents also show a direct antagonistic ability against pathogens by eliminating pathogens that colonize seeds or roots of plants (Taylor *et al.*, 1985).

Seed priming is an important tool to improve emergence of crops, especially under the stress conditions (Rakshit *et al.*, 2014). Earlier works showed that combining seed priming with bio-control agent application ultimately resulted in improvement in crops and different methods were utilized for bio-priming (Harman and Taylor 1988; Callan *et al.*, 1991; Jensen *et al.*, 2004; and El-Mohamedy and Abd–El-Baky, 2008). *Trichoderma* spp. is the most common saprophytic fungus in rhizosphere which act as mycoparasite on pathogenic fungi and on the other hand it stimulates plant growth as well (Singh *et al.*, 2013b; Rakshit *et al.*, 2015 and Meena *et al.*, 2016). *Trichoderma* spp. is a well-known bio-control agent used in seed bio-priming (Harman and Taylor, 1988; El-Mohamedy and Abd–El-Baky, 2008; Pill *et al.*, 2009).

Vegetative growth and total fresh pods yield

Data presented in Table (8) showed that seed treatments led to statistical increases in the vegetative growth of pea plants expressed as plant length, leaves and branches number/ plant, as well as fresh and dry weight of leaves, stems, pods and seeds and total green pods yield (ton/fed). The results revealed that the highest values of vegetative growth characters of pea plant were obtained by bio-priming seeds, seed coating and priming seeds in a descending order, respectively compared with control. These results were similar and true in the two seasons of the experiments.

These results were in agreement with those El-Mohamedy and Abd-El-Baky (2008) evaluated the effect of different types of seed treatments on improvement of growth and yield quality of pea plant and reported that bio-priming with *T. harzianum* or *Bacilus subtilis* were the most effective treatment stimulating vegetative growth with highest values of plant height, number of leaves/ plant and branches/ plant. These treatments also significantly increased early and total fresh pods yield. Similarly, Saxena *et al*. (2015) reported enhancement in root and shoot lengths along with dry weight of plants with significant increase in the number of leaf in the plants treated with the Trichodemra isolate BHUF4.

It was well studied that *Trichoderma spp*. enhances plant growth by increasing nutrient uptake (Harman *et al.*, 2004; Rakshit *et al.*, 2013) along with induction of secondary root development through auxins and indoles production (Contreras-conrnejo *et al.*, 2009, 2014 a, b). Vivek *et al*. (2016) showed that bio-priming enhancement in plant growth in the treated plants as compared to control. There was increase in shoot length, root length, number of leaves, shoot fresh weight, root fresh weight, shoot dry weight and root dry weight by 35.29, 96.49, 28.13, 36.10, 146.26, 30.17 and 77.20 %, respectively, as compared to the control.

Effect of the interactions

The interaction between cultivars and phosphorus fertilizer levels:

Damping-off and root rot incidence: Data presented in Table (9) clear that pea root rot disease incidence was recorded after 30 and 60 days of sowing. Results show that all phosphorus levels combined with cv. Master B reduced the incidence of root rot on pea plants until 60 days compared with other interactions during two seasons. Phosphorus fertilizer levels at 50 and 75 P_2O_5/ feddan were highly effective then 25 units/ fed in decreasing the percentage of root rot infection of MB cultivar during two seasons. The interaction between treatment of 75 P_2O_5/ feddan and cv. MB caused reduction of root rot disease incidence reach to 57.44 and 50.65 % at pre emergence stage during two seasons, respectively and reduced the incidence of pea root rot by 37.65, 52.72 % and 52.71, 48.93 % at post emergency after 30 and 60 days after sowing date during two seasons, respectively. The pre-emergence damping off, i. e. infection and reduction (%) and post-emergence root rot disease, i. e. incidence and reduction (%) after 30 days of sowing during the first season did not reach a significant difference's. Meanwhile, the interaction between 75 P_2O_5/ feddan and cv. MB cause a reduction in the incidence of pea root rot estimated by 50.68 and 52.67 % after 40 and 60 days of sowing during the second season. The highly percentages of survival plants of MB cultivar were recorded with 50 and 75 P_2O_5 unit treatments.

Many investigators reported that, increasing phosphorus rates above the level needed to grow the crop can increase the severity of *Fusarium wilt* in muskmelon (Jones *et al*., 1989).

Vegetative growth and total fresh pods yield

Data presented in Table (10) revealed that the highest values of vegetative growth characters of pea plants expressed as plant length, leaves and branches number/plant, as well as fresh and dry weight of leaves, stems, pods and seeds and total green pods yield (ton/fed) were obtained by the combination effect of Master B cultivar with application of mineral phosphorus fertilizer at the rate of 50 kg P_2O_5/ fed compared with treatments in both seasons. Branches number/ plant during two seasons and stem fresh weight at the first season were not significant. Lower values were obtained by other interactions. The lowest values of vegetative growth were obtained by var. Litel Marvel without phosphorus. Results of green yield were with the same trend of vegetative growth. The highest green yield was obtained by Master B var. which receiving 50 kg P_2O_5/ fed.

The interaction between phosphorus levels and seed treatments on pea root rot incidence

Damping-off and root rot incidence: Results in Table (11) indicated that combination between phosphorus levels and seed treatments have high effectiveness in reducing damping-off root rot disease on pea plants. Bio-priming combined with 50 and / or 75 P_2O_5 /feddan were the highly effective treatments in decreasing the percent of disease infection on pea plants at pre and post - emergence stages. These treatments reduced pea root rot disease at pre-emergence stage by 85.82, 88.46 % and 78.33, 81.74 % during two seasons, respectively and root rot at post emergence stage by 74.21, 79.32 % and 80.85, 82.92 % after 30 and 60 days of sowing, respectively during the first season and 78.42, 77.41 % and 81.35, 80.03 % after 30 and 60 days of sowing, respectively during the second season.

These results are in accordance with those observed by El-abd *et al.* (2013) who indicated that the combined effect of bio-priming + 50 and/or 75 P_2O_5/ feddan resulted the highest efficacy in reduced root rot disease caused by *Fusarium* spp.; *Rhizoctonia solani* and *Sclerotium rolfsii* on pea plant at both pre and post emergence stage.

Considerable disease control was achieved when seed coating treatment was combined with 50 and/or 75 P_2O_5 units /feddan treatments. These treatments reduced pea root rot at pre-emergence stage by more 63.85, 69.06 % and 57.19, 62.93 % on pea plants during two seasons, respectively. The interaction between seed priming and phosphorus fertilizer levels show the least records of disease reduction compared with bio-priming and seed coating treatments. The highest percent of healthy and survival pea plants were recorded with bio-priming and seed coating combined with 50 and 75 P_2O_5 /feddan, i.e. 88.25, 73.50 and 92.25, 79.25 at the first season and 86.15, 71.75% and 86.50, 75.25 % at the second season.

Vegetative growth and total fresh pods yield: Data in Table (12) show that the highest values of vegetative growth characters of pea plants expressed as plant length, leaves and branches number/plant, as well as fresh and dry weight of leaves, stems, pods and seeds and total green pods yield (ton/fed) were obtained by the combination effect of mineral phosphorus fertilizer at the rate of 50 kg P_2O_5/ fed. and bio-priming compared with other treatments in the two seasons. Branches number/ plant and leaves fresh weight was not significant during two seasons. The lowest values of vegetative growth were obtained by without mineral phosphorus fertilizer and without seed treated.

Results of green yield were with the same trend of vegetative growth. The highest green yield was obtained by seed bio-priming treatment which receiving 50 kg P_2O_5/ feddan follow up the treatment of seed bio-priming which receiving 75 kg P_2O_5/ feddan at the first season. These results are in accordance with those observed by El-abd *et al.* (2013) who reported that inoculation of pea seed before sowing by bio-priming treatments combined with addition of mineral phosphorus resulted in the highest significant increase in vegetative growth, green pod yield and quality of pea grown in sandy soil. Phosphorus is an important nutrient that is essential for plant growth and development which is generally present in unavailable form. Many microorganisms including *Trichoderma* spp. produce organic acids and phosphatase that solubilize the unavailable phosphate to available phosphate that can be easily absorbed by plants. *Trichoderma* spp. also helps to increase the nitrogen use efficiency in plants (Rakshit *et al*., 2015).

The interaction between cultivars and seed treatments

Damping-off and root rot incidence: Results in Table (13) indicated that combination between cultivars of pea and seed treatments have high significant differences in reducing root rot disease on pea plants at both pre and post-emergence stages. MB cultivar is superior cultivar combination with bio-priming or seed coating treatments in reducing root rot disease on pea plants compared with LM cultivar with other seed treatments. Meanwhile, combination between LM cultivar and seed priming show less effect in decreasing the disease incidence on LM cultivar of pea.

Seeds of cv. MB combined with bio-priming treatment were the highly effective treatments in decreasing the percent of disease infection on pea plants at post -emergence stage. These treatments reduced pea root rot disease and post-emergence stage by 84.46 % and 78.16 % during two seasons, respectively and root rot at post emergence stages by 75.66, 76.86 % and 78.96, 77.01 % after 30 and 60 days of transplanting date, respectively during the first season and 78.42, 77.41 % and 81.35, 80.03 % after 30 and 60 days of sowing, respectively during the second season. The interaction between cv. LM and seed priming treatment show the least records of disease reduction compared with bio- priming and seed coating treatments with cv. MB. The highest percent of healthy and survival pea plants were recorded by cv. MB combined with seed bio-priming and seed coating, i.e. 90.38, 72.88 and 85.50, 7.038 during two seasons, respectively. These results are in accordance with those observed by El-Mohamedy and Abd–El-Baky, 2008 on peas.

Vegetative growth and total fresh pods yield

Data presented in Table (14) showed that the highest values of vegetative growth characters of pea plants expressed as plant length, leaves and branches number/plant, as well as fresh and dry weight of leaves, stems, pods and seeds and total green pods yield (ton/fed) were obtained by the combination effect of cv. Master B with seed bio-priming treatment. The lowest values of vegetative growth characters and total pods yield were obtained by sowing of cv. Little Marvel seeds combined with without seeds treatment (control). These results were similar and true in the two seasons of the experiments. Dry weight of leaves and stems two seasons and branches numbers at the second season were not significant.

The interaction between cultivars, phosphorus levels and seed treatments

Damping-off and root rot incidence: Data presented in Tables (15 and 16) clear that pea root rot disease incidence was recorded after 30 and 60 days of sowing. Results show that all phosphorus levels reduced the incidence of root rot until 60 days on pea of cv. MP with bio priming and seed coating treatments during two seasons. Phosphorus fertilizer levels at 50 and 75 P_2O_5 /feddan/ feddan were highly effective then 25 P_2O_5 /feddan in decreasing the percentage of root rot infection of cv. MB with bio priming during two seasons. The treatment of 75 unit of phosphorus fertilizer with bio priming treatment reduced pea root rot disease of cv. MB at post-emergence stage by 85.02 % and 91.90 % during two seasons, respectively and reduced the incidence of pea root rot by 82.50, 82.93 % and 84.38, 81.58 % after 30 and 60 days after sowing date during two seasons, respectively. The highly percentages of survival plants of cv. MB were recorded with 50 and 75 P_2O_5 and bio priming treatment. The infection and reduction percentage of damping off during the first season didn't reach to significant differences.

b) - Vegetative growth and total fresh pods yield: Data presented in Tables (17 and 18) show that the highest values of vegetative growth characters of pea plants expressed as plant length, leaves and branches number/ plant, as well as fresh and dry weight of leaves, stems, pods and seeds and total green pods yield (ton/fed) were obtained by the combination effect of cv. Master B, mineral phosphorus fertilizer at the rate of 50 kg P_2O_5/ fed and seed bio-priming compared with other treatments in the two seasons. Branches number/ plant in the two seasons and leaves fresh weight, leaves, stems and pods dry weight in the second season were not significant. The lowest values of vegetative growth were obtained by plants cv. LM which cultivated without mineral phosphorus fertilizer and without seed treated.

CONCLUSION

It can be concluded from the present investigation that pea growers may use poor quality seeds with high incidence of seed borne fungi. Bio-priming of seeds is the modern technique for seed quality enhancement and can be used in integrated management of seed borne diseases. Before recommendation for field application, it is necessary to standardize hours of soaking for bio-priming. It was found that four hour soaking of seeds in water or in suspension of bio-control agent was the most effective in seed quality parameters. Recommend by using pea seeds of cv. Master B in cultivation and using bio-primed seeds with bio-control agents like *T. harzianum* or *T. viride* or *T. asperellum* should be utilized for managing seed borne pathogens and fertilizing pea plants by adding mineral phosphorus fertilizer at the rate of 50 or 75 kg P_2O_5/ feddan for improving pods yield and quality seeds.

Table 3. Effect of cultivars on post-emergence damping off incidence percentage, root rot disease incidence percentage and survival plans of pea plants during two seasons 2014/2015 and 2015/2016.

Cultivars	Post-emergence damping off (%) Infection (%)	Root rot disease incidence (%) After 30 day	After 60 day	Survival Plant (%)
		First season (2014/2015)		
Little Marvel	11.56	14.38	15.04	59.29
Master B	9.91	11.91	9.47	63.38
L.S.D at 0.05	0.02	0.06	0.02	0.02
		Second season (2015/2016)		
Little Marvel	14.14	14.80	15.01	56.10
Master B	11.56	11.89	10.80	64.72
L.S.D at 0.05	0.02	0.06	0.02	0.03

Table 4. Effect of cultivars on vegetative growth and total fresh pods yield of pea during two seasons (2014/2015 and 2015/2016).

Cultivars	Plant Length (cm)	Leaves No./ plant	Branches No./ plant	Fresh weight (g/ plant)				Dry weight (g/ plant)				Total pods yield (ton/ fed.)
				Leaves	Stems	Pods	Seeds	Leaves	Stems	Pods	Seeds	
	First season (2014/2015)											
Little Marvel	63.94	22.56	2.17	18.14	7.41	43.73	21.96	7.94	3.15	4.98	6.20	4.414
Master B	64.90	25.88	2.71	24.02	6.99	63.13	37.00	9.32	3.37	5.98	11.08	6.728
L.S.D at 0.05	N.S.	0.94	N.S.	0.28	N.S.	1.06	0.92	0.32	N.S.	0.13	0.11	0.090
	Second season (2015/2016)											
Little Marvel	61.67	19.04	1.98	17.87	7.21	43.93	22.17	6.46	1.96	4.13	5.30	4.442
Master B	62.06	21.94	2.38	20.47	7.44	53.40	31.97	7.85	2.06	4.94	7.53	5.737
L.S.D at 0.05	N.S.	0.68	N.S.	0.85	N.S.	0.41	0.69	0.16	N.S.	0.07	0.10	0.041

Table 5. Effect of phosphorus levels on post-emergence damping off incidence percentage, root rot disease incidence percentage and survival plans of pea plants during two seasons (2014/2015 and 2015/2016).

Phosphorus Levels (P_2O_5)/fed.	Post-emergence damping off (%) Infection (%)	Root rot disease incidence (%) After 30 day	After 60 day	Survival Plant (%)
	First season (2014/2015)			
0	10.28	12.39	11.45	51.04
25	9.25	11.19	10.44	54.47
50	7.88	10.23	9.38	57.91
75	6.94	9.06	8.56	61.72
L.S.D at 0.05	0.23	0.20	0.02	0.02
	Second season (2015/2016)			
0	12.26	13.27	12.51	49.08
25	11.19	11.41	11.47	53.00
50	9.63	9.59	9.44	58.38
75	8.81	9.05	8.60	60.53
L.S.D at 0.05	0.02	0.05	0.02	0.04

Table 6. Effect of phosphorus levels on vegetative growth and total fresh pods yield of pea during two seasons (2014/2015 and 2015/2016).

P levels	Plant Length (cm)	Leaves No./ plant	Branches No./ plant	Fresh weight (g/ plant)				Dry weight (g/ plant)				Total pods yield (ton/ fed.)
				Leaves	Stems	Pods	Seeds	Leaves	Stems	Pods	Seeds	
	First season (2014/2015)											
0	52.02	18.60	1.58	14.19	4.29	37.14	21.72	5.95	2.23	3.99	6.48	3.956
25	55.94	22.58	2.02	19.75	5.00	48.34	26.08	7.41	2.88	4.62	8.35	5.001
50	61.33	25.10	2.77	25.64	9.11	63.40	32.74	9.65	3.07	6.08	9.61	6.461
75	59.77	23.27	2.63	19.11	8.58	49.01	27.61	9.49	4.09	5.95	7.65	5.149
L.S.D at 0.05	1.06	1.08	0.18	0.83	0.40	1.15	0.54	0.37	0.19	0.26	0.20	0.097
	Second season (2015/2016)											
0	51.38	15.10	1.71	15.52	5.79	36.21	20.35	5.33	1.32	3.45	4.73	3.80
25	55.85	18.19	1.79	17.59	6.64	43.53	23.84	6.15	1.84	3.95	6.27	4.53
50	58.27	21.13	2.46	19.86	7.43	49.43	28.26	7.40	2.07	4.29	7.10	5.22
75	54.04	19.29	2.06	17.25	6.76	46.08	24.97	6.85	2.05	4.58	5.41	4.77
L.S.D at 0.05	0.50	0.37	0.16	1.41	0.18	1.06	0.71	0.13	0.10	0.10	0.23	0.094

Table 7. Effect of seed treatments on post-emergence damping off incidence percentage, root rot disease incidence percentage and survival plans of pea plants during two seasons (2014/2015 and 2015/2016).

Seed treatments	Post-emergence damping off (%) Infection (%)	Root rot disease incidence (%) After 30 day	After 60 day	Survival Plant (%)
		First season (2014/2015)		
Control	17.19	19.42	18.40	40.40
Bio-priming	3.63	6.09	5.00	86.13
Priming	14.56	17.67	17.13	47.00
Seed coating	7.56	9.40	8.50	71.81
L.S.D at 0.05	0.24	0.15	0.02	0.02
		Second season (2015/2016)		
Control	19.02	20.10	19.21	41.29
Bio-priming	5.75	5.94	5.31	82.48
Priming	17.00	17.02	16.35	49.06
Seed coating	9.63	10.31	10.75	68.81
L.S.D at 0.05	0.02	0.06	0.02	0.04

Table 8. Effect of seed treatments on vegetative growth and total pods yield of pea during two seasons (2014/2015 and 2015/2016).

Seed treatments	Plant Length (cm)	Leaves No./plant	Branches No./plant	Fresh weight (g/ plant)				Dry weight (g/ plant)				Total pods yield (ton/ fed.)
				Leaves	Stems	Pods	Seeds	Leaves	Stems	Pods	Seeds	
	First season (2014/2015)											
Control	57.21	14.63	1.50	11.24	3.63	31.63	19.52	4.03	1.55	2.54	4.97	3.438
Bio-priming	70.83	35.00	3.46	31.26	11.40	80.64	40.08	12.82	5.51	8.35	12.37	8.112
Priming	63.04	19.21	2.17	16.42	5.49	45.16	27.74	7.00	2.27	4.80	7.72	4.899
Seed coating	66.58	28.04	2.63	25.39	8.28	56.28	30.58	10.66	3.71	6.22	9.52	5.837
L.S.D at 0.05	1.09	1.21	0.22	1.26	0.41	1.57	0.79	0.38	0.28	0.43	0.24	0.113
	Second season (2015/2016)											
Control	55.83	16.50	1.38	12.92	5.37	38.84	21.72	5.76	1.52	3.70	4.29	4.069
Bio-priming	68.17	25.08	2.96	24.90	9.10	58.77	34.68	8.25	2.38	5.30	9.74	6.280
Priming	59.96	19.25	2.00	17.95	6.43	45.48	24.60	6.90	2.00	4.45	5.14	4.709
Seed coating	63.50	21.13	2.38	20.91	8.41	51.59	27.28	7.69	2.13	4.69	6.49	5.300
L.S.D at 0.05	0.74	0.50	0.21	1.90	0.22	1.16	1.05	0.21	0.14	0.14	0.22	0.107

Table 9. Effect of the interaction between cultivars and phosphors levels on post-emergence damping off incidence percentage, root rot disease incidence percentage and survival plan percentage of pea during two seasons (2014/2015 and 2015/2016).

Cultivars	Phosphors levels	Post-emergence damping off (%) Infection (%)	Root rot disease incidence (%) After 30 day	After 60 day	Survival Plant (%)
		First season (2014/2015)			
Little Marvel	0	13.50	16.44	16.92	53.42
	25	12.00	15.13	15.50	57.75
	50	10.88	13.71	14.50	61.00
	75	9.88	12.25	13.25	65.00
Master B	0	11.88	13.63	11.00	57.50
	25	10.88	12.25	10.13	60.63
	50	9.00	11.50	8.75	65.38
	75	7.88	10.25	8.00	70.00
L.S.D at 0.05		N.S.	N.S.	0.03	0.03
		Second season (2015/2016)			
Little Marvel	0	16.42	17.83	17.29	48.71
	25	15.13	15.75	16.25	52.88
	50	12.88	13.13	13.63	60.33
	75	12.13	12.50	12.88	62.50
Master B	0	13.50	14.38	13.00	58.13
	25	12.00	12.38	11.63	63.00
	50	10.88	10.75	9.75	67.63
	75	9.88	10.04	8.83	70.13
L.S.D at 0.05		0.03	0.09	0.03	0.06

Table 10. Effect of the interaction between cultivars with phosphorus levels on vegetative growth and total fresh pods yield of pea during two seasons (2014/2015 and 2015/2016).

Cultivars	P levels	Plant Length (cm)	Leaves No./ plant	Branches No./ plant	Fresh weight (g/ plant)				Dry weight (g/ plant)				Total pods yield (ton/ fed.)
					Leaves	Stems	Pods	Seeds	Leaves	Stems	Pods	Seeds	
		First season (2014/2015)											
Little Marvel	0	56.42	14.75	1.50	11.48	3.58	30.41	16.24	4.58	1.84	3.05	4.87	3.135
	25	61.33	17.83	1.67	15.81	4.44	34.75	16.39	5.70	2.00	3.75	6.06	3.437
	50	68.83	30.08	2.83	24.96	11.37	60.72	23.61	10.54	3.31	6.42	6.48	5.667
	75	69.17	27.58	2.67	20.32	10.26	49.05	31.60	10.92	5.47	6.69	7.40	5.419
Master B	0	59.92	25.17	1.92	18.51	5.66	48.38	30.42	7.83	2.92	5.49	9.19	5.296
	25	64.08	31.17	2.75	26.26	6.24	68.31	40.09	10.26	4.16	5.92	11.80	7.284
	50	69.92	24.50	3.17	30.42	7.93	78.26	47.97	10.10	3.27	6.47	13.99	8.482
	75	65.67	22.67	3.00	20.86	8.11	57.55	29.51	9.11	3.12	6.03	9.36	5.850
	L.S.D at $_{0.05}$	1.83	1.87	N.S.	1.43	0.70	2.00	0.93	0.63	0.32	0.45	0.34	0.167
		Second season (2015/2016)											
Little Marvel	0	56.33	15.25	1.75	15.48	6.48	34.58	16.90	4.58	1.51	3.46	3.62	3.460
	25	63.50	19.83	1.83	19.29	6.96	44.50	22.80	6.67	2.06	3.88	5.38	4.523
	50	65.25	21.75	2.25	19.20	8.13	49.33	24.56	7.19	2.15	4.43	6.20	4.966
	75	61.58	19.33	2.08	17.52	7.27	47.32	24.41	7.38	2.13	4.75	6.01	4.820
Master B	0	58.58	18.17	1.92	17.93	6.08	43.80	27.66	6.83	1.42	4.08	6.62	4.802
	25	62.83	20.92	2.08	19.44	7.78	52.90	29.91	7.15	1.99	4.90	8.20	5.565
	50	66.50	25.33	3.08	23.96	8.22	60.35	38.79	9.43	2.49	5.20	9.45	6.663
	75	60.33	23.33	2.42	20.54	7.68	56.56	31.52	7.98	2.33	5.57	5.83	5.919
	L.S.D at $_{0.05}$	0.86	0.64	N.S.	N.S.	N.S.	N.S.	1.23	0.23	N.S.	N.S.	0.40	0.162

Table 11. Effect of interaction between phosphorus levels and seed treatments on post-emergence damping off incidence percentage, root rot disease incidence percentage and survival plans percentage of pea during two seasons (2014/2015 and 2015/2016).

P levels	Seed Treat.	Post-emergence damping off (%) Infection (%)	Root rot disease incidence (%) After 40 day	Root rot disease incidence (%) After 60 day	Survival Plant (%)
		First season (2014/2015)			
0	Control	19.25	21.17	20.08	35.33
	Bio-priming	5.25	7.71	7.00	80.00
	Priming	17.25	20.08	18.25	41.50
	Seed coating	9.00	11.17	10.50	65.00
25	Control	17.50	20.00	19.00	37.75
	Bio-priming	4.25	6.75	5.50	84.00
	Priming	15.75	17.92	17.50	45.50
	Seed coating	8.25	10.08	9.25	69.50
50	Control	16.50	19.00	18.00	42.25
	Bio-priming	2.75	5.50	4.00	88.25
	Priming	13.50	17.00	16.75	48.75
	Seed coating	7.00	8.92	7.75	73.50
75	Control	15.50	17.50	16.50	46.25
	Bio-priming	2.25	4.42	3.50	92.25
	Priming	11.75	15.67	16.00	52.25
	Seed coating	6.00	7.42	6.50	79.25
	L.S.D at 0.05	0.58	0.36	0.05	0.05
		Second season (2015/2016)			
0	Control	21.58	22.67	21.08	34.67
	Bio-priming	7.50	8.25	7.00	76.75
	Priming	19.75	20.25	19.00	40.50
	Seed coating	11.00	13.25	13.50	61.75
25	Control	19.00	21.25	19.75	39.50
	Bio-priming	6.75	6.25	6.00	80.50
	Priming	18.25	18.00	18.00	45.25
	Seed coating	10.25	10.75	12.00	66.50
50	Control	18.00	18.75	18.00	44.75
	Bio-priming	4.75	4.50	4.00	86.15
	Priming	15.50	15.50	15.25	53.25
	Seed coating	9.25	9.00	9.50	71.75
75	Control	17.50	17.75	18.00	46.25
	Bio-priming	4.00	4.75	4.25	86.50
	Priming	14.50	14.33	13.15	57.25
	Seed coating	8.00	8.25	8.00	75.25
	L.S.D at 0.05	0.05	0.14	0.05	0.10

Table 12. Effect of the interaction between phosphorus levels and seed treatments on vegetative growth and total pods yield of pea during two seasons (2014/2015 and 2015/2016).

P levels	Seed treatments	Plant Length (cm)	Leaves No./ plant	Branches No./ plant	Fresh weight (g/ plant)				Dry weight (g/ plant)				Total pods yield (ton/ fed.)
					Leaves	Stems	Pods	Seeds	Leaves	Stems	Pods	Seeds	
					First season (2014/2015)								
0	Control	49.17	10.83	1.00	6.43	2.60	18.04	12.87	2.03	1.22	2.21	4.37	2.077
	Bio-priming	65.50	32.83	2.67	24.75	7.70	60.26	32.33	9.17	3.52	6.12	9.89	6.222
	Priming	56.67	13.33	1.33	10.60	3.44	33.89	23.60	5.09	1.93	4.16	6.39	3.863
	Seed coating	61.33	22.83	1.83	18.19	4.74	45.40	24.53	8.54	2.87	4.60	7.47	4.699
25	Control	54.17	15.33	1.50	10.27	2.76	25.48	17.26	4.55	1.65	1.72	4.67	2.872
	Bio-priming	70.33	37.50	3.00	32.42	8.19	80.30	37.85	11.44	5.04	8.28	11.74	7.940
	Priming	60.17	17.83	1.83	15.27	4.11	44.24	26.50	6.13	2.05	4.38	8.96	4.753
	Seed coating	66.17	27.33	2.50	26.19	6.31	56.10	31.34	9.80	3.59	4.95	10.37	5.876
50	Control	64.33	17.50	1.83	16.36	4.31	48.72	24.41	5.35	1.72	2.92	5.03	4.914
	Bio-priming	73.33	33.67	4.00	37.73	16.37	97.91	47.16	15.97	5.52	9.81	16.35	9.748
	Priming	68.50	26.50	3.00	26.07	8.52	57.56	34.25	9.68	2.61	5.51	7.83	6.169
	Seed coating	71.33	31.50	3.17	30.60	9.39	73.78	37.36	10.28	3.30	7.54	11.73	7.468
75	Control	61.17	14.83	1.67	11.90	4.84	34.29	23.55	4.22	1.62	3.30	5.82	3.887
	Bio-priming	74.17	36.00	4.17	30.14	13.32	84.08	42.96	14.73	7.98	9.19	11.50	8.537
	Priming	66.83	19.17	2.50	13.76	5.90	44.96	26.61	7.08	2.51	5.16	7.69	4.810
	Seed coating	67.50	30.50	3.00	26.58	12.68	49.86	29.08	14.04	5.08	7.78	8.51	5.305
L.S.D at 0.05		2.66	2.96	N.S.	N.S.	1.00	3.85	1.92	0.94	0.68	1.04	0.58	0.277
					Second season (2015/2016)								
0	Control	48.67	12.83	1.00	9.43	3.88	23.87	15.49	3.03	1.22	2.55	3.12	2.645
	Bio-priming	64.17	20.50	2.83	23.59	8.82	51.93	29.13	7.69	1.77	4.78	8.14	5.447
	Priming	56.17	15.33	1.50	13.60	4.89	35.11	20.24	5.07	1.37	3.83	3.89	3.719
	Seed coating	60.83	18.17	2.00	20.19	7.52	45.85	24.28	7.04	1.51	3.93	5.33	4.713
25	Control	58.50	17.50	1.33	14.23	5.81	41.37	20.13	6.10	1.46	3.48	4.12	4.133
	Bio-priming	70.17	24.00	2.67	24.62	9.03	59.34	37.21	8.01	2.45	5.28	10.14	6.488
	Priming	61.00	19.33	1.83	18.45	6.49	42.97	22.29	6.62	2.05	4.29	5.22	4.385
	Seed coating	63.00	20.67	2.00	20.17	8.16	51.12	25.80	6.92	2.13	4.50	7.67	5.169
50	Control	60.83	19.33	1.67	13.77	6.01	43.29	27.30	7.28	2.00	4.15	5.80	4.743
	Bio-priming	72.50	28.17	3.33	27.35	9.63	68.15	40.46	8.99	2.61	5.62	12.18	7.298
	Priming	62.67	22.17	2.50	21.14	7.15	51.84	29.06	8.21	2.27	4.48	6.45	5.436
	Seed coating	67.50	24.50	3.17	24.06	9.93	56.10	29.89	8.74	2.39	5.00	6.89	5.778
75	Control	55.33	16.33	1.50	14.25	5.76	46.81	23.96	6.63	1.43	4.62	4.11	4.756
	Bio-priming	65.83	27.67	3.00	24.04	8.93	55.66	31.93	8.33	2.67	5.50	8.50	5.885
	Priming	60.00	20.17	2.17	18.61	7.19	52.00	26.80	7.71	2.31	5.18	5.00	5.295
	Seed coating	62.67	21.17	2.33	19.24	8.03	53.28	29.17	8.05	2.50	5.33	6.08	5.540
L.S.D at 0.05		1.82	1.22	N.S.	N.S.	0.53	2.84	2.56	0.51	N.S.	0.34	0.55	0.261

Table 13. Effect of the interaction between cultivars and different seed treatments on post-emergence damping off incidence percentage, root rot disease incidence percentage and survival plans percentage of pea during two seasons (2014/2015 and 2015/2016).

Cultivars	Seed treatments	Post-emergence damping-off (%) Infection (%)	Root rot incidence (%) After 30 day	Root rot incidence (%) After 60 day	Survival Plant (%)
		First Season 2014/2015			
Little Marvel	Control	17.63	20.71	22.42	39.04
	Bio-Priming	4.38	7.31	6.63	81.88
	Priming	15.50	18.71	20.63	45.50
	Seed Coating	8.75	10.79	10.50	70.75
Master B	Control	16.75	18.13	14.38	41.75
	Bio-Priming	2.88	4.88	3.38	90.38
	Priming	13.63	16.63	13.63	48.50
	Seed Coating	6.38	8.00	6.50	72.88
L.S.D at 0.05		0.33	0.21	0.03	0.03
		Second Season 2014/2015			
Little Marvel	Control	20.42	21.83	21.29	36.71
	Bio-priming	7.13	7.13	6.25	79.45
	Priming	18.50	18.50	19.00	44.00
	Seed Coating	10.50	11.75	13.50	64.25
Master B	Control	17.63	18.38	17.13	45.88
	Bio-priming	4.38	4.75	4.38	85.50
	Priming	15.50	15.54	13.70	54.13
	Seed Coating	8.75	8.88	8.00	73.38
L.S.D at 0.05		0.03	0.08	0.03	0.06

Table 14. Effect of the interaction between cultivars and seed treatments on vegetative growth and total pods yield of pea during two seasons (2014/2015 and 2015/2016).

Cultivars	Seed treatments	Plant Length (cm)	Leaves No./ plant	Branches No./ plant	Fresh weight (g/ plant)				Dry weight (g/ plant)				Total pods yield (ton/ fed.)
					Leaves	Stems	Pods	Seeds	Leaves	Stems	Pods	Seeds	
		First season (2014/2015)											
Little Marvel	Control	56.50	12.58	1.25	9.85	3.72	24.68	11.04	3.73	1.45	2.40	2.39	2.400
	Bio-priming	71.17	32.50	2.92	27.32	11.88	64.03	32.97	12.05	5.68	7.16	9.93	6.518
	Priming	61.25	20.08	2.08	14.81	5.99	35.71	20.84	6.10	2.06	4.41	5.79	3.800
	Seed coating	66.83	25.08	2.42	20.59	8.05	50.51	22.99	9.86	3.44	5.93	6.71	4.939
Master B	Control	57.92	16.67	1.75	12.63	3.53	38.59	28.01	4.34	1.66	2.67	7.55	4.475
	Bio-priming	70.50	37.50	4.00	35.20	10.91	97.24	47.18	13.60	5.35	9.54	14.81	9.705
	Priming	64.83	18.33	2.25	18.04	5.00	54.62	34.64	7.89	2.49	5.20	9.65	5.998
	Seed coating	66.33	31.00	2.83	30.19	8.51	62.06	38.17	11.46	3.98	6.50	12.32	6.735
L.S.D at 0.05		1.54	1.71	0.30	1.78	N.S.	2.22	1.11	N.S.	N.S.	0.60	0.34	0.160
		Second season (2015/2016)											
Little Marvel	Control	55.00	15.75	1.08	11.05	5.40	32.33	16.30	4.95	1.36	3.11	3.00	3.268
	Bio-priming	70.00	23.50	2.67	23.98	8.64	57.47	33.37	7.59	2.42	5.05	8.26	6.105
	Priming	58.42	18.08	1.92	17.23	6.52	37.51	18.50	6.17	1.93	4.07	4.17	3.763
	Seed coating	63.25	18.83	2.25	19.24	8.28	48.42	20.51	7.12	2.13	4.29	5.79	4.632
Master B	Control	56.67	17.25	1.67	14.79	5.33	45.34	27.14	6.57	1.69	4.29	5.58	4.871
	Bio-priming	66.33	26.67	3.25	25.82	9.56	60.06	35.99	8.92	2.33	5.55	11.22	6.455
	Priming	61.50	20.42	2.08	18.68	6.34	53.45	30.69	7.64	2.07	4.82	6.11	5.655
	Seed coating	63.75	23.42	2.50	22.59	8.54	54.76	34.06	8.25	2.14	5.09	7.20	5.968
	L.S.D at 0.05	1.05	0.70	N.S.	N.S.	0.31	1.64	1.48	N.S.	N.S.	0.20	0.32	0.151

Table 15. Effect of the integration between Cultivars, phosphors level and seed treatment on post-emergence damping off incidence percentage, root rot disease Incidence percentage and survival plans percentage of pea during the first season 2014/2015.

Cultivars	Phosphors Level	Seed treatments	Post-emergence damping-off (%) Infection (%)	Root rot incidence (%) After 40 day	Root rot incidence (%) After 60 day	Survival Plant (%)
Little Marvel	0	Control	20.00	22.33	24.17	34.17
		Bio-Priming	6.00	8.92	9.00	75.50
		Priming	18.00	22.17	22.00	40.00
		Seed Coating	10.00	12.33	12.50	64.00
	25	Control	17.50	21.00	23.00	37.00
		Bio-Priming	5.00	8.50	7.50	80.00
		Priming	16.50	19.33	20.50	45.00
		Seed Coating	9.00	11.67	11.00	69.00
	50	Control	17.00	20.50	22.00	40.50
		Bio-Priming	3.50	6.50	5.50	84.00
		Priming	14.50	17.50	20.50	46.50
		Seed Coating	8.50	10.33	10.00	73.00
	75	Control	16.00	19.00	20.50	44.50
		Bio-Priming	3.00	5.33	4.50	88.00
		Priming	13.00	15.83	19.50	50.50
		Seed Coating	7.50	8.83	8.50	77.00
Master B	0	Control	18.50	20.00	16.00	36.50
		Bio-Priming	4.50	6.50	5.00	84.50
		Priming	16.50	18.00	14.50	43.00
		Seed Coating	8.00	10.00	8.50	66.00
	25	Control	17.50	19.00	15.00	38.50
		Bio-Priming	3.50	5.00	3.50	88.00
		Priming	15.00	16.50	14.50	46.00
		Seed Coating	7.50	8.50	7.50	70.00
	50	Control	16.00	17.50	14.00	44.00
		Bio-Priming	2.00	4.50	2.50	92.50
		Priming	12.50	16.50	13.00	51.00
		Seed Coating	5.50	7.50	5.50	74.00
	75	Control	15.00	16.00	12.50	48.00
		Bio-Priming	1.50	3.50	2.50	96.50
		Priming	10.50	15.50	12.50	54.00
		Seed Coating	4.50	6.00	4.50	81.50
L.S.D at 0.05			N.S.	0.51	0.07	0.07

Table 16. Effect of the integration between Cultivars, phosphors level and seed treatment on post-emergence damping off incidence percentage, root rot disease incidence percentage and survival plans percentage of pea during the second season 2015/2016.

Cultivars	Phosphors Level	Seed treatments	Post-emergence damping-off (%) Infection (%)	Root rot incidence (%) After 40 day	Root rot incidence (%) After 60 day	Survival Plant (%)
Little Marvel	0	Control	23.17	24.83	23.17	29.83
		Bio-Priming	9.00	9.50	8.00	73.50
		Priming	21.50	22.00	21.50	35.00
		Seed Coating	12.00	15.00	16.50	56.50
	25	Control	20.50	23.50	22.00	34.00
		Bio-Priming	8.50	7.50	7.00	77.00
		Priming	20.00	20.00	21.00	39.00
		Seed Coating	11.50	12.00	15.00	61.50
	50	Control	19.00	20.00	20.00	41.00
		Bio-Priming	6.00	5.50	5.00	83.30
		Priming	16.50	17.00	17.50	49.00
		Seed Coating	10.00	10.00	12.00	68.00
	75	Control	19.00	19.00	20.00	42.00
		Bio-Priming	5.00	6.00	5.00	84.00
		Priming	16.00	15.00	16.00	53.00
		Seed Coating	8.50	10.00	10.50	71.00
Master B	0	Control	20.00	20.50	19.00	39.50
		Bio-Priming	6.00	7.00	6.00	80.00
		Priming	18.00	18.50	16.50	46.00
		Seed Coating	10.00	11.50	10.50	67.00
	25	Control	17.50	19.00	17.50	45.00
		Bio-Priming	5.00	5.00	5.00	84.00
		Priming	16.50	16.00	15.00	51.50
		Seed Coating	9.00	9.50	9.00	71.50
	50	Control	17.00	17.50	16.00	48.50
		Bio-Priming	3.50	3.50	3.00	89.00
		Priming	14.50	14.00	13.00	57.50
		Seed Coating	8.50	8.00	7.00	75.50
	75	Control	16.00	16.50	16.00	50.50
		Bio-Priming	3.00	3.50	3.50	89.00
		Priming	13.00	13.67	10.30	61.50
		Seed Coating	7.50	6.50	5.50	79.50
L.S.D at $_{0.05}$			0.07	0.20	0.07	0.14

Table 17. Effect of the interaction between cultivars, phosphorus levels and seed treatments on post-emergence damping off incidence percentage, root rot disease incidence percentage and survival plans percentage of pea during the first season (2014/2015).

Cultivars	P levels	Seed treatments	Plant Length (cm)	Leaves No./ plant	Branches No./ Plant	Fresh weight (g/ plant)				Dry weight (g/ plant)				Total pods yield (ton/ fed.)
						Leaves	Stems	Pods	Seeds	Leaves	Stems	Pods	Seeds	
First season (2014/2015)														
Little Marvel	0	Control	46.33	8.33	1.00	5.04	2.57	6.39	4.18	2.07	1.23	1.73	1.73	0.710
		Bio-priming	63.67	23.33	2.00	19.28	5.14	50.13	23.14	6.68	2.59	3.83	8.40	4.924
		Priming	53.33	13.00	1.33	7.85	2.93	22.27	18.26	3.48	1.56	3.14	3.92	2.724
		Seed coating	62.23	14.33	1.67	13.73	3.66	42.86	19.37	6.10	1.99	3.49	5.44	4.182
	25	Control	51.33	11.33	1.00	9.70	2.44	11.72	6.80	3.27	1.43	1.59	1.83	1.245
		Bio-priming	68.33	26.67	2.33	22.61	6.34	55.47	26.14	7.55	2.79	5.69	9.40	5.484
		Priming	58.33	16.00	1.33	14.19	4.13	27.27	15.70	5.01	1.59	3.34	6.11	2.888
		Seed coating	67.33	17.33	2.00	16.73	4.86	44.53	16.93	6.97	2.19	4.37	6.92	4.130
	50	Control	63.00	15.00	1.33	10.74	4.03	46.71	7.30	4.32	1.30	2.59	2.37	3.629
		Bio-priming	74.33	39.00	3.67	39.71	21.42	74.42	38.21	17.36	6.03	9.33	10.31	7.568
		Priming	67.00	30.00	3.33	22.99	10.24	53.86	22.53	9.65	2.54	6.21	6.24	5.133
		Seed coating	71.00	36.33	3.00	26.40	9.77	67.89	26.43	10.81	3.35	7.55	7.00	6.338
	75	Control	65.33	15.67	1.67	13.93	5.85	33.90	25.87	5.24	1.83	3.71	3.62	4.017
		Bio-priming	78.33	41.00	3.67	27.67	14.63	76.09	44.41	16.60	11.30	9.79	11.61	8.098
		Priming	66.33	21.33	2.33	14.21	6.64	39.42	26.87	6.27	2.53	4.94	6.89	4.455
		Seed coating	66.67	32.33	3.00	25.49	13.90	46.78	29.23	15.57	6.20	8.32	7.49	5.108
Master B	0	Control	52.00	13.33	1.00	7.83	2.62	29.69	21.56	1.99	1.21	2.70	7.01	3.444
		Bio-priming	67.33	42.33	3.33	30.23	10.26	70.39	41.51	11.65	4.45	8.40	11.39	7.520
		Priming	60.00	13.67	1.33	13.35	3.95	45.51	28.93	6.69	2.29	5.18	8.86	5.002
		Seed coating	60.33	31.33	2.00	22.65	5.82	47.94	29.69	10.97	3.75	5.70	9.50	5.217
	25	Control	57.00	19.33	2.00	10.83	3.08	39.25	27.72	5.82	1.87	1.84	7.51	4.500
		Bio-priming	72.33	48.33	3.67	42.23	10.04	105.14	49.57	15.32	7.28	10.87	14.08	10.396
		Priming	62.00	19.67	2.33	16.35	4.08	61.20	37.30	7.25	2.50	5.42	11.80	6.619
		Seed coating	65.00	37.33	3.00	35.65	7.75	67.67	45.76	12.63	4.99	5.53	13.81	7.622
	50	Control	65.67	20.00	2.33	21.98	4.59	50.72	41.51	6.37	2.14	3.25	7.68	6.198
		Bio-priming	72.33	28.33	4.33	35.74	11.33	121.39	56.11	14.58	5.00	10.29	22.39	11.928
		Priming	70.00	23.00	2.67	29.15	6.80	61.26	45.96	9.71	2.67	4.81	9.43	7.206
		Seed coating	71.67	26.67	3.33	34.80	9.01	79.66	48.28	9.74	3.25	7.52	16.45	8.598
	75	Control	57.00	14.00	1.67	9.87	3.82	34.69	21.23	3.19	1.41	2.90	8.01	3.758
		Bio-priming	70.00	31.00	4.67	32.61	12.02	92.06	41.51	12.85	4.65	8.60	11.39	8.976
		Priming	67.33	17.00	2.67	13.32	5.15	50.51	26.35	7.89	2.49	5.38	8.50	5.165
		Seed coating	68.33	28.67	3.00	27.67	11.46	52.94	28.93	12.51	3.95	7.24	9.53	5.502
		L.S.D at 0.05	3.76	4.18	N.S.	4.37	1.41	5.44	2.72	1.33	0.96	1.48	0.83	0.392

Table 18. Effect of the interaction between cultivars, phosphorus levels and seed treatments on vegetative growth and total pods yield of pea during the second season (2015/2016).

Cultivars	P levels	Seed treatments	Plant Length (cm)	Leaves No./ plant	Branches No./ Plant	Fresh weight (g/ plant)				Dry weight (g/ plant)				Total pods yield (ton/fed.)
						Leaves	Stems	Pods	Seeds	Leaves	Stems	Pods	Seeds	
						First season (2014/2015)								
Little Marvel	0	Control	46.33	10.33	1.00	9.04	5.14	16.39	8.70	2.07	1.23	2.23	1.29	1.686
		Bio-priming	63.33	19.33	2.33	23.28	8.04	50.13	25.80	6.68	1.92	4.33	6.65	5.103
		Priming	53.33	15.00	1.67	11.85	5.83	25.61	15.18	3.48	1.33	3.64	2.57	2.741
		Seed coating	62.23	16.33	2.00	17.73	6.89	46.20	17.93	6.10	1.56	3.65	3.97	4.309
	25	Control	57.33	18.33	1.00	12.79	5.25	33.83	15.99	5.69	2.86	2.86	2.29	3.348
		Bio-priming	73.67	23.61	2.67	23.61	8.04	59.06	2.52	7.62	5.14	5.14	7.65	6.655
		Priming	59.67	18.33	1.67	20.09	6.38	16.28	16.28	6.51	3.70	3.70	3.91	3.511
		Seed coating	63.33	19.00	2.00	20.68	7.81	49.15	18.97	6.86	3.81	3.81	7.65	4.577
	50	Control	60.33	19.00	1.33	9.67	5.62	34.00	17.99	5.60	1.36	3.58	3.79	3.494
		Bio-priming	74.33	25.33	3.00	24.48	9.55	70.08	40.64	8.18	2.73	5.50	11.72	7.440
		Priming	61.67	21.00	2.00	20.85	6.48	42.70	19.26	7.06	2.17	4.05	4.51	4.163
		Seed coating	64.67	21.67	2.67	21.79	10.88	50.56	20.35	7.90	2.34	4.58	4.78	4.765
	75	Control	56.00	15.33	1.00	12.72	5.60	45.12	22.51	6.43	1.50	3.78	4.60	4.545
		Bio-priming	68.67	25.67	2.67	24.53	8.57	50.62	27.06	7.88	2.51	5.21	7.00	5.221
		Priming	59.00	18.00	2.33	16.11	7.37	45.76	23.28	7.61	2.12	4.88	5.68	4.639
		Seed coating	62.67	18.33	2.33	16.74	7.53	47.76	24.79	7.62	2.38	5.11	6.75	4.875
Master B	0	Control	51.00	15.33	1.00	15.67	2.62	31.36	22.27	3.99	1.21	2.88	4.95	3.604
		Bio-priming	65.00	21.67	3.33	25.62	9.59	53.72	32.45	8.69	1.62	5.23	9.62	5.791
		Priming	59.00	15.67	1.33	16.81	3.95	44.61	25.29	6.65	1.41	4.01	5.20	4.698
		Seed coating	59.33	20.00	2.00	19.65	8.15	45.51	30.63	7.97	1.45	4.20	6.69	5.116
	25	Control	59.67	16.67	1.67	15.67	6.37	48.91	24.27	6.52	1.56	4.10	5.95	4.918
		Bio-priming	66.67	24.33	2.67	9.65	9.65	59.62	34.45	8.40	2.38	5.42	12.62	6.321
		Priming	62.33	20.33	2.00	6.60	6.60	49.99	28.29	6.72	2.00	4.88	6.54	5.260
		Seed coating	62.67	22.33	2.00	19.65	8.50	53.09	32.63	6.98	2.01	5.20	7.69	5.760
	50	Control	61.33	19.67	2.00	17.88	6.40	52.59	36.60	8.96	2.63	4.73	7.81	5.993
		Bio-priming	70.67	31.00	3.67	30.21	9.70	66.22	40.29	9.81	2.49	5.74	12.64	7.157
		Priming	63.67	23.33	3.00	21.43	7.82	60.97	38.86	9.36	2.38	4.92	8.38	6.709
		Seed coating	70.33	27.33	3.67	26.33	8.97	61.64	39.43	9.57	2.45	5.41	8.99	6.791
	75	Control	54.67	17.33	2.00	15.78	5.93	48.50	25.41	6.83	1.36	5.46	3.61	4.967
		Bio-priming	63.00	29.67	3.33	23.54	9.28	60.69	36.79	8.78	2.83	5.79	9.99	6.550
		Priming	61.00	22.33	2.00	21.12	7.00	58.24	30.32	7.81	2.49	5.48	4.31	5.952
		Seed coating	62.67	24.00	2.33	21.74	8.53	58.79	33.55	8.48	2.63	5.56	5.41	6.205
L.S.D at 0.05			2.58	1.73	N.S.	N.S.	0.75	4.01	3.62	N.S.	N.S.	N.S.	0.77	0.369

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التاثير المتداخل بين التسميد الفوسفاتي والمقاومة الحيوية لبذور بسلة مهيئة وغير مهيئة للانبات لمرض موت البادرات وعفن الجذور وانعكاسه على تحسين النمو والمحصول الغض للقرون

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الملخص العربي

اجريت تجربتين حقليتين فى التربة المستصلحة حديثا لمدة موسمين شتويين متعاقبين خلال الفترة من ٢٠١٥/٢٠١٤ الى ٢٠١٦/٢٠١٥ في منطقة النوبارية، محافظة البحيرة، مصر، لدراسة تاثير مستويات مختلفة من الفسفور ومعاملات البذور البيولوجية على السيطرة على امراض سقوط البادرات وعفن الجذور وتحسين النمو وانتاجية القرون الطازجة لصنفي البسلة (لتل مارفل – ماستر بي). استخدم في هذه الدراسة اربعة مستويات من السماد الفوسفاتي المعدني (صفر، ٢٥، ٥٠ و٧٥ كجم فو٢ا٥/ فدان في تداخل مع اربعة معاملات بيولوجية للبذور] بذور غير معاملة (الكنترول)، بذور مهياة للانبات ومعاملة بجراثيم فطر الترايكودرما هيريزيانم، واخيرا بذور مغلفة بجراثيم فطر الترايكودرما هيريزيانم. تم تسجيل حدوث مرض عفن الجذور في نباتات البسلة بعد ٣٠ و٦٠ يوم من زراعة البذور. اشارت النتائج ان اعلى نمو خضري واعلى محصول غض للقرون واحسن صفات جودة لنباتات البسلة امكن الحصول عليها بزراعة الصنف (ماستر بي) بالمقارنة بالصنف (لتل مارفل). كما اشارت النتائج ان القيم العالية للصفات السابقة الذكر يمكن تسجيلها بواسطة نباتات البسلة التي سمدت بمعدل ٥٠ كجم فو٢ا٥/ فدان بالمقارنة بالمستويات الاخرى. كانت مستويات السماد الفوسفاتي ٥٠ و٧٥ وحدة فوسفور اكثر فعالية بالمقارنة بالمستوى ٢٥ وحدة فوسفور/ فدان في تقليل النسبة المئوية للاصابة الناتجة عن مرض موت البادرات وعفن الجذور وتقليل حدوثه في نباتات البسلة .معاملات المقاومة الحيوية اختلفت معنويا في تاثيرها في تقليل النسبة المئوية لحدوث مرض سقوط البادرات، وزيادة النمو الخضري والمحصول الغض للقرون في نباتات البسلة. كانت معاملة البذور المهياة للنبات والمعاملة بالفطر المضاد اكثر المعاملات حماية لنباتات البسلة يليها معاملة البذور المغلفة بجراثيم فطر الترايكوديرما هيريزيانم بالمقارنة بنباتات الكنترول (البذور غير المعاملة). نباتات البسلة النامية من البذور المهياة للنبات والمعاملة بالفطر المضاد كانت متفوقة في نموها النباتي معبرا عنه بطول النبات؛ عدد الاوراق والفروع/ نبات؛ الوزن الطازج والجاف للاوراق والسيقان والقرون والبذور ومحصول القرون الطازجة (طن / فدان) مقارنة مع غيرها من معاملات البذور البيولوجية. كما اعطت النباتات التي هيئت بذورها للنبات وعوملت بالفطر المضاد اعلى صفات نمو خضري واعلى محصول قرون طازجة بالمقارنة بالنباتات غير المعاملة (الكنترول). ادى التاثير المتداخل بين مستويات الفوسفور ومعاملة البذور بالفطريات المضادة الى حدوث زيادة معنوية في صفات النمو الخضري ومحصول القرون الطازجة وجودة القرون لنباتات البسلة. امكن الحصول على اعلى القيم للنمو الخضري ومحصول القرون الطازجة عن طريق زراعة بذور البسلة صنف (ماستر بي) المهياة للانبات والمعاملة بالفطر المضاد قبل الزراعة بالتداخل مع اضافة السماد الفوسفاتي المعدني بمعدل ٥٠ كجم وحدة فوسفور/ فدان لنباتات البسلة. وبالمثل، اشارت النتائج الى ان التاثير المشترك لمعاملة تهيئة البذور ومعاملتها بالفطر المضاد ومعدلات السماد الفوسفاتي له فعالية عالية في الحد من حدوث مرض سقوط البادرات ومرض عفن الجذور في نباتات البسلة. كانت تهيئة البذور ومعاملتها بالفطر المضاد جنبا الى جنب مع معدلات السماد الفوسفاتي ٥٠ و / او ٧٥ وحدة فوسفور/ فدان هو العلاج الفعال للغاية في تقليل النسبة المئوية للاصابة بالامراض التربة (موت البدرات وعفن الجذور) في البسلة.

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