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Effect of Some Climatic Conditions and Some Fertilization Treatments on Productivity Quality of Bean Plants As Weii As Their Relationship with Rust Disease

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Abstract

The present study was conducted at a private farm in El-Khatateba – Sadat City- Menofyia Governorate location during 2019/2020 and 2020/2021 to evaluate the effect of foliar spraying with some organic fertilizers (green organic magic, green power and compost tea on growth, seed yield and seed quality of three dry beans cultivars (Giza 6, Giza 10 and Nebraska), as well as the impact of those fertilizers on the severity of the three cultivars of rust diseases. The obtained results showed a wide diversity among all tested cultivars in growth, yield and quality traits. All bean studied traits significantly affected by the differences organic fertilizer treatments in both seasons. Giza 6 cv. had the highest number of pods/plant, number of seeds/pods, number of seeds/plant and seed yield/fad in addition to the lowest percentages of disease severity and disease incidence of rust, in both seasons. Nebraska cv expressed the highest number, 100-seed weight as well as seed contents of; moisture, total protein, total carbohydrates, total soluble sugar and total phenolic in both seasons. Bean plants that treated with Green power gave the highest; number of pods/plant, number of seeds/plant, 100-seed weight, seed yield/fad and the highest seed contents of; moisture, total protein, total carbohydrates, total soluble sugar and total phenolic in both seasons. Bean plants that sprayed with Green power recorded the lowest disease severity and disease incidence and this reduction in both severity and incidence associated with the highest efficacy of disease reduction in both seasons. As for the interaction Giza 6 cv that treated with Green power had the highest; number of pods/plant and seed yield/fad in both seasons. Giza 6 cv that sprayed with Green organic magic recorded the lowest disease severity, disease incidence and the highest efficacy of disease reduction in both seasons. Nebraska cv that treated with Green power had the highest seed contents of moisture, total protein, total carbohydrates, total soluble sugar and total phenolic in both seasons. The results confirmed that seed yield/fed significant negative associated with rust disease severity

Keywords: Beans- Organic fertilizers – Rust disease

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Introduction:

Common bean is one of the most important legume crops. It is the source of nutrition, especially for low-income people. In developing countries it is often considered a good alternative for animal protein in poor societies (Tharanathan and Mahadevamma, 2003). Green or dry seeds of common bean are rich in protein, fiber, iron, carbohydrate and minerals (Ozturk et al., 2009). Common bean consumption reduces the risk of chronic diseases such as cancer diabetes cardiovascular diseases and obesity (Ahmad et al., 2014). Common had a short life cycle where it matures quickly, supplies food, income and enhances soil fertility through nitrogen fixation (Wortmann et al., 1998).

The provision of the needs of bean plants from the nutrients are important for the highest production of seeds, although the short lifecycle of bean plant, deficient of nutrients for growth and production leads to a significant reduction in the seed yield, which affects the final return and significant economic losses to bean cultivators. It was found that reduce of phosphorous by 75 %, 65% of nitrogen and 20% the acidic, causing deficiency of most of the essential nutrients required for common bean production (Lunze et al., 2012). Most of the cultivated lands in developing countries suffer from severe lack of fertility and a sharp decline in the organic matter this is mostly due to many reasons and misguided practices such as continuous cropping, inappropriate cropping system with little or no input to replenish soil fertility, inadequate resources to allocate to soil improvement by smallholder farmers lack of soil fertility maintenance plan, increasing population, inadequate supply of organic and inorganic fertilizers, use low efficiency nutrient , inappropriate fertilizer recommendation and different in response to fertilizers (Rao et al., 2016).

To provide the needs of bean plants with nutrients, farmers are mostly to add these elements to the plant. The application of chemical nutrients causes environmental problems and negatively affects the health and life of living organisms, especially human, which causes on imbalance in the ecosystem, leading to water and air pollution as well as killing many birds and natural enemies. The search for bio and organic alternatives fertilizers to chemical fertilizers is one of the most important optimal solutions to preserve the environment from pollution. Many studies in the last two decades have established the importance of using organic fertilization to reduce the use of mineral insecticides and fungicides in controlling pests caused air and water pollution make environmental hazards **(Zaker, 2016)**. Moreover it has recently been reported that *B. fabae* and *B. cinerea* become more resistance to those chemicals pesticides **(Maggie *et al*. 2006)** as a result of the previous dangerous of chemical pesticides it is very important to search for new environmental friendly alternatives for the control of these pests. In recent times studies have tended to use plant extracts as safe alternatives to chemical pesticides. Certain chemical inducers.Ascorbic acid, salicylic acids and Houmic acids revealed the most superior positive resistance effect among other inducers. One of the most important used to combat fungal diseases. In additional to increasing the yield, enzyme and fenole activites in comparison with control treatment.

fertilizers or these artificial creatures because they have an effective role in improving the yield and quality of many crops with great environmental safe.

Organic fertilizers are new generation of fertilizers where it is the dominant trend over the whole world because it is safe component at the environment and humans, birds, fishes and animals. The use of chemical fertilizers, insecticides and fungicides caused air and water pollution make environmental hazards (Zaker, 2016). Moreover it has recently been reported that Botrytes sp. become more resistance to those chemicals pesticides (Maggie et al. 2006) as a result of the previous dangerous of chemical components it is very important to search for new environmental friendly alternatives for feeding plants and control of these pests. The environmental hazard caused by the excessive use of chemical pesticides or fertilizer, organic-fertilization become a great alternative in legume and non-legume crops to reduce this pad effect of chemical substances. Organic fertilizers are products consisting of living cells of many kinds of microorganisms that have the ability to convert complex important elements from unavailable to available forms through biological processes (Seddigh and Kiani, 2018). In the previous studies it was found that vegetative growth, dry seed yield and the quality attributes of common bean plants significantly affected by chicken manure tea. This effect may be attributed to a higher EC value of chicken manure tea (Shaheen et al., 2018). Also, Mahmoud and Gad (2020) showed that organic fertilizers positively affected all growth and yield traits except number of pods. Ahmadi and Arain (2021) found that organic fertilizer significantly improved grain yield in addition, it had positive effects on growth and yield attributes of common bean. Ibrahim et al., (2021) showed that use of compost tea at 100 l ha-1 significantly increased canopy height, number of branches plant-1, number of leaves plant-1, leaf area plant-1, shoot dry matter, number of pods plant-1, pod length, pod weight plant-1, and green pods yield.

Yield of common bean significantly affected by several pest and diseases (Abebe et al., 2013). Rusts, powdery and downy mildew, ascochyta blights are the major fungal foliar diseases (Singh and Schwartz, 2010). Common bean is attacked by the pathogenic rust fungi, Uromyces appendiculatus (Pers.), of which the pathogen development is influenced by environmental conditions as temperature and humidity, and host factors such as leaf age (Singh and Schwartz 2010). Bean rust caused by Uromyces appendeculatus is a major prevalent disease in the cultivations of beans as in other parts of the world (Chhetry and Mangang 2012). Bean rust is widely spread all over

governorates of Egypt. There are great differences among the governorates, whereas the highest percentage of infection and severity were recorded in Ismailia governorate followed by Beheira and Menofyia governorates (Tadrous et al., 2008).Control of bean rust is achieved using resistant cultivars (Alzate-Marin et al., 2004) and application of certain fungicides in addition to develop plant nutrition statues (Arslan et al., 2006). Organic fertilizers are also, recorded to be used as sources of useful microorganisms in controlling of insects and fungal diseases in plants by foliar spray or soil application (Addisu, 2017 and Haba, 2018). In addition microorganisms in the compost are effective

in enhancing the plant growth and defense against several pests by antibiosis, competition, mycoparasitism, cell wall degradation enzymes and induced systemic resistance.

According to the previous discussions the present study was aimed to determine the efficacy of organic fertilizers in increasing seed yield and its component of common bean in addition to the role of these fertilizers in reducing rust severity on common beans under field conditions.

Materials And Methods

- The field experiment:
- Materials:

A field study was conducted at the private farm in El-Khatateba – Sadat City-Menofyia Governorate location during 2019/2020 and 2020/2021 to evaluate the effect of foliar spraying with some organic fertilizers (green organic magic, green power and compost tea on seed yield and seed quality of three dry beans cultivars (Giza 6, Giza 10 and Nebraska), as well as the impact of those fertilizers on the severity of the three varieties to rust. The experimental soil physical and chemical properties are presented in Table 1. While some agro-climatological data of the experimental location during 2019/2020 and 2020/2021 are presented in Table 2.

- Methods:
- The experiment layout.

In both seasons of 2019/2020 and 2020/2021 the three bean cultivars Giza 6, Giza 10 and Nebraska seeds were sown in the first week of October in field experiment designed in split plot with three replicates, where the three bean cultivars were allocated in the main plots and fertilizers treatment were randomly distributed in the sub-plots. The plot size was four ridges. Each ridge was three meters long and 70 cm apart. Seeds were sown on both sides on the ridge at 15 cm hill spacing with one seed per hill. The wet planting method called (Herati) was used and all the other

cultural practices were followed as recommended. Nile water is available in this area with drip irrigation system.

Table 1: Soil physical and chemical properties of the experimental site

Parameters	2019/2020	2020/2021
Physical properties		
Sand %	9.07	3.05
Silt %	33.37	35.57
Clay %	57.20	61.20
Organic matter	0.63	0.71
Texture	Clay	Clay
Chemical properties		
Ph	7.69	7.63
EC (ds/m)	0.83	0.91
CaCO3 (%)	0	0
Soluble cations (meq/100 g soil)		
Ca++	3.22	3.49
Mg++	2.24	2.36
Na+	3.32	3.41
K+	0.16	0.18
Soluble anions (meq/100 g soil)		
HCO3-	1.77	2.06
Cl-	2.66	3.05
SO4--	4.47	4.81

Table 2: Some agro-climatological data of El-Khatateba – Sadat City- Menofyia Governorate location during 2019/2020 and 2020/2021.

Month	Average air temperature		Relative humidity %		Wind speed m/s	
	2019/2020	2020/2021	2019/2020	2020/2021	2019/2020	2020/2021
Oct.	24.65	25.48	53.85	52.61	2.71	2.63
Nov.	20.37	18.86	53.56	61.82	2.26	2.73
Dec.	14.47	15.73	64.01	60.94	2.89	2.16
Jan.	11.95	14.18	67.47	60.12	2.93	2.55

The meteorological data of temperature, relative humidity, wind speed and soil temperature, were obtained from Central Laboratory for Agricultural Climate (CLAC), Agricultural Research Centre (ARC), during the two growing seasons of 2019/2020 and 2020/2021.

Treatments

The three fertilizers treatments green organic magic, green power and compost tea from Agricultural Research Centre (ARC), were sprayed individually at the rate of 15 ml/1 L.W three times during bean growth started at the 1st of Nov. and repeated twice every 15 days after the first one in both seasons of the study. The chemical compositions of the

three used fertilizers are presented in Tables 3, 4 and 5.

Table 3: chemical compositions of green organic magic.

Component	Percentage (%)
Organic acids	10.00
Amino acids	5.00
Seaweed extract	15.00
Nitrogen	3.00
Phosphorus	2.00
Potassium	6.00

Table 4: Chemical compositions of green power.

Component	Percentage (%)
Humic acids	10.00
Fulvic acids	10.00
Amino acids	10.00
Potassium	12.00

Table 5: Chemical compositions of compost tea.

Component	Percentage (%)
Organic matter	37.00
Amino acids	3.00
Organic acids	12.00
Nitrogen	2.30
Phosphorus	3.50
Potassium	5.00

Data Recorded.

Ten guarded plants randomly taken from each sub-pot were used at harvest to determine the following recorded:

Yield traits: number of pods/plant, number of seeds/pod, number of seeds/plant, 100-seeds/weight (g) and seed yield/faddan (kg). Note, seed yield/ faddan were estimated by convert seed yield/plot to faddan.

Seed quality traits: seed content of moisture (g/100g DW), seed content of total protein (g/100g DW), seed content of total carbohydrates (g/100g DW), seed content of soluble sugar (g/100g DW) and seed content of total phenolic (mg/100g DW).

Determination of protein

Protein content in seeds was determined by protein analyzer apparatus model (LC 3000 Eppendorf, Central Lab. of Desert Research Center). Hydrolysis was carried out according to the method of Pellet and Young (1980).

Determination of carbohydrates percentage in seed

Total carbohydrate determined in 0.5 g accurately weight and extracted with 1 M HCL and the volume of extract raised to 50 ml after neutralization, precipitation and filtration. Total carbohydrate content determined calorimetrically at 540 nm according to Miller

(1959) with DNS method and the concentration estimated from the calibration standard curve.

Determination of soluble sugars

Total soluble sugars were colorimetrically determined using the picric acid method as described by Thomas and Dutcher (1924).

Polyphenol oxidase (PPO) activity

Polyphenol oxidase activity was estimated as described by Mayer and Harel (1979) with some modifications. The polyphenol oxidase activity was expressed as change in absorbance at 495 nm against blank per min g fresh leaves.

Disease assessment

Rust disease severity was recorded under the natural infection on the field experiment after 7 weeks from complete appearance of rust symptoms. Disease incidence % (DI %) and disease severity % (DS %) of the rust developed were weekly after the appearance of the first symptoms. In each plot thirty leaflets were chosen randomly with five canopy levels: top, middle and bottom and were rated non-destructively each week till harvest in accordance with the methodology of Imhoff et al., (1982). Five categories were suggested to estimate the severity rusted leaves using a scale in which 0,1,2,3,4 and 5 signified that 0, 1-10, 11 -25, 26-50, 51 -75 and 76-100 % of the leaf surface was covered with pustules , respectively of Claudia et al., (1992).

The statistical parameters were calculated as follows:

i) DI % = (Number of leaves infected / Total No. of leaves studied) X 100

ii) DS % = (Sum of numerical ratings / (No. of leaves examined X maximum grade) X 100

- Statistical Analysis: Results were expressed as mean. The data were analyzed by using Two-way ANOVA followed by LSD test through SPSS 16 (version 4). The treatments means were compared using least significant difference (LSD) tested at significant levels of 5% and 1% respectively as described by Gomez and Gomez (1984).

Results And Discussions

Effect of cultivars, treatments and their interaction on bean yield.

Results in Table 6 showed that all yield traits i.e. number of pods/plant, number of seeds/pods, number of seeds/plant, 100-seed weight and seed yield/fad of bean plants significantly affected by cultivars, treatments and their interactions in both seasons. These differ confirmed the wide diversity between the three cultivars in their genetic. While, the differences in all yield traits under the different treatments may be due the differences in chemical compositions of these treatments as shown in Tables 3, 4 and

Effect of cultivars

The presented data in Table 6 cleared wide diversity between the three bean cultivars in all yield traits i.e. number of pods/plant, number of seeds/pods, number of seeds/plant, 100-ssed weight and seed yield/fad in both seasons. Giza 6 cv showed the highest; number of pods/plant (5.43 and 5.02), number of seeds/pods (4.55 and 4.85), number of seeds/plant (24.73 and 24.40) and seed yield/fad (1216.85 and 1185.51 kg) in both seasons, respectively. While, Nebraska cv gave the highest 100-seed weight (50.44 and 49.78 g) in the first and second seasons, respectively. In contrary, Giza 10 cv showed the lowest number of pods/plant (4.88 and 4.56), 100-seed weight (38.55 and 38.05 g) and seed yield/fad (966.89 and 952.15 kg) in both seasons, respectively. The differences among common bean genotypes in all yield traits may due to the wide genetic diversity among these genotypes. These differences were reported by many studies before such as, Yoseph et al., (2014) who found significant variation observed among the common bean varieties for all the yield and yield components except number of seeds per pod. Ersulo, and Dana (2018) evaluated the performance of fifteen released common bean varieties and one local cultivar and found significant variation for all yield and seed quality traits except maturity date among all tested genotypes. Kazai et al., (2019) found valuable genetic variability for all yield traits of common bean.

Effect of treatments

The obtained data in Table 6 revealed that all bean yield traits significantly affected by the different treatments. All used treatments resulted in significant improvements in all yield traits compared to control. Bean plants that treated with green power gave the highest; number of pods/plant (5.93 and 5.41), number of seeds/plant (24.55 and 24.53), 100-seed weight (45.90 and 45.30 g) and seed yield/fad (1338.87 and 1318.66 kg) in both seasons, respectively followed by green organic magic and compost tea in all growth traits. In the same way the highest seed number/pod as shown by bean plants that treated with green organic magic with averages of 4.47 and 4.53 in the first and second seasons, respectively. On the other side, bean plants under the control treatment had the lowest; number of pods/plant (4.23 and 4.10), number of seeds/plant (16.93 and 17.49), 100-seed weight (39.61 and 39.09 g) and seed yield/fad (797.93 and 817.41 kg) in both seasons, respectively. All organic fertilization treatments had a great impact on improving all bean yield traits in both seasons compared to control. Organic fertilizers can improve in soil nutrient status and crop productivity (Martin 2014). Several studies confirmed the positive effect of organic fertilizers on legumes yield such as Abdel-Mawgoud (2006) who, found that common bean yield components responded positively to compost application. El-Sayed et al., (2015) showed that spraying snap bean plants with pigeon manure tea maximized yield and it's components as compared to the

control. Abo-Sedera et al., (2016) showed that, sprayed snap bean plants with organic fertilizers improve total produced green pods yield and its components as compared with the control. Aslani and Souri (2018) reported that foliar applications of organic-chelate fertilizers improved pod number and pod yield compared to control plants. Mahmoud and Gad (2020) showed that vermi-fertilizer (VC 100%) positively affected all yield traits except individual number of pods of common bean. Ibrahim et al., (2021) showed that use of compost tea at 100 l ha-1 significantly increased number of pods plant-1, pod length, pod weight plant-1 and green pods yield compared with the use of 50 l ha-1 and control.

Common bean plants that sprayed with green power exceeded these plants that sprayed with Green organic magic and seaweed extract as well as the control treatment. These exceeded may be due the different between the in their chemical composition. Green power consisted of 10% organic acid, 5% amino acid, 15% seaweed extract, 3% nitrogen, 2% phosphorus and 6% potassium. Organic acids have shown a significant impact on improving plant growth and yield according to previous studies such as a study by Mohajerani et al., (2016) who revealed that the highest seed yield of red bean (4253.7 kg/ha) was reported at 1.5 liter per hectare of humic acid application. Also, Abd-Elaziz et al., (2019) indicated that treated broad bean plants with humic acid increased seed yield fed-1. Abdel-Baky et al., (2019) revealed that increasing fulvic acid increased application increased the seed and straw yield of faba bean. El-Sawy et al., (2020) indicated that the maximum values of pod length and diameter, fresh and dry weights of pods and total green pods yield per feddan were obtained with application of 6 g/L of fulvic acid.

Despite of organic matter in improving vegetable crops, the effects these substances are significantly reduced in the absence of mineral fertilization. For example, Nitrogen is thus essential nutrient for plant growth, development and reproduction because N is a major component of chlorophyll, the compound by which plants use sunlight energy to produce sugars from water and carbon dioxide. It is also a major component of amino acids, the building blocks of proteins. In addition to nitrogen is very important nutrient for plant growth due to being a part of amino acid, protein and enzymes and chlorophyll molecules (Brady and Weil 2002). Also, Phosphorus as a plant-essential nutrient plays a dynamic role from germination to maturity viz., root development, flower and seed formation, strengthening of stem and stalk, fixation of nitrogen in legume crop and crop resistance to diseases (Hao 2002). Phosphorus is the primary essential element for plant growth that makes up approximately 0.2% dry weight of plant (Dorahy et al., 2004). While potassium plays a major role in plant growth and production. It maintains turgor pressure of cell which is necessary for cell expansion. It helps in osmo-regulation of cell, assists in opening and closing of stomata. It plays a key role in activation of more than

60 enzymes (Bukhsh et al., 2011). Green power contains balanced ratios of N, P and K. Many studies confirmed the importance of N, P and K fertilization in maximizing yields for all crops such as the study of Rahman et al., (2014) who showed that foliar spray of NPK significantly increased number of pods plant-1, number of seeds pod-1, number of seeds plant-1, biomass and grain yield of common bean. Chantal et al., (2019) showed that NPK: 18-46-30 enhanced the yield and number of pods, grains and full pods.

Effect of the interaction

The results in Table 6 clear that the three bean cultivars differ in their response to the different treatments in all yield traits. In general the data indicated that sprayed bean plants with green power resulted in significant improve in all yield traits of the three bean cultivars compared with the other treatments as well as control. Giza 6 cv that sprayed with Green power had the highest; number of pods/plant (6.34 and 5.78) and seed yield/fad (1462.53 and 1435.03 kg) while, bean plants that sprayed with green organic magic had the highest seeds number/pod (5.30 and 5.80) and seeds number/plant (28.44 and 28.36) in both seasons, respectively. In the same line Nebraska cv that sprayed with green power showed the highest 100-seed weight with averages of 53.20 and 52.20 in the first and second seasons, respectively.

The three common bean cultivars in this study differ in all yield traits under all treatments and the control similar results were obtained before by Yoseph et al., (2014), Ersulo, and Dana (2018) and Kazai et al., (2019) who found a wide variation among common bean genotypes in all yield traits. On the other side, all tested organic fertilizers exceeded the control in improving yield and yield components traits of the three common bean cultivars. These findings are in the same line with those of; Abdel-Mawgoud (2006), Aslani and Souri (2018), Mahmoud and Gad (2020) and Ibrahim et al., (2021) in common bean. El-Sayed et al., (2015) and Abo-Sedera et al., (2016) in snap bean.

Effect of cultivars, treatments and their interaction on bean yield quality.

Data in Table 7 indicated that seed contents of total protein, total carbohydrates, soluble sugar and total phenolic as well as seed moisture content significantly affected by cultivars, treatments and their interactions in both seasons.

Effect of cultivars

The obtained data in Table 7 confirmed that the seeds of the three bean cultivars differ in their contents of moisture, total protein, total carbohydrates, soluble sugar and total phenolic in both seasons. Nebraska cv had the highest seed contents of; moisture (15.10 and 14.90 g/100g), total protein (30.53 and 30.13 g/100 g), total carbohydrates (39.69 and 39.16 g/100 g), total soluble sugar (3.42 and 3.38 g/100 g)

and total phenolic (51.34 and 50.67 mg/100 g) in both seasons, respectively followed by Giza 6 cv in all seed quality. In contrast, Giza 10 cv showed the lowest seed contents of; moisture (12.32 and 12.16 g/100g), total protein (23.77 and 23.46 g/100 g), total carbohydrates (30.89 and 30.50 g/100 g), total soluble sugar (2.66 and 2.63 g/100 g) and total phenolic (41.87 and 41.33 mg/100 g) in both seasons, respectively. The three bean cultivars in the present study differ in their seed chemical composition these differ may to the genetic variation. These findings are in agreement with those reported by; Ersulo, and Dana (2018) who evaluated the performance of Fifteen released common bean varieties and one local cultivar and found significant variation for all seed quality traits among all tested common bean genotypes. Also, Kazai et al., (2019) found valuable genetic variability for the important quality seed traits protein, carbohydrate and mineral contents of common bean.

Table 6: Effect of cultivars, treatments and their interaction on bean yield and its components.

Factors		No. pods/plant		number of seeds/pod		number of seeds/plant		100-seeds weight (g)		seed yield /fad. (kg)	
Cultivars		1st Season	2nd Season	1st Season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Giza 6		5.4	5.0	4.5	4.8	24.	24.	40.	40.	121	118
Giza 10		4.8	4.5	4.2	4.5	20.	20.	38.	38.	966.	952.
Nebraska		4.9	4.5	3.6	3.9	17.	17.	50.	49.	108	106
LSD 5%		0.1	0.0	0.1	0.1	1.1	1.1	2.1	2.0	41.6	38.8
Treatments											
Control		4.2	4.1	4.0	4.2	16.	17.	39.	39.	797.	817.
Green		5.1	4.6	4.4	4.8	22.	22.	44.	43.	120	117
Green		5.9	5.4	4.1	4.5	24.	24.	45.	45.	133	131
Compost		5.0	4.5	3.9	4.1	19.	19.	43.	42.	101	966.
LSD 5%		0.0	0.0	0.0	0.0	0.4	0.4	0.6	0.6	27.0	25.7
Cultivars	Treat.										
Giza 6	Control	4.3	4.2	4.2	4.2	18.	18.	38.	37.	842.	810.
	Green	5.3	4.8	5.3	5.8	28.	28.	41.	40.	141	138
	Green	6.3	5.7	4.4	4.8	27.	27.	43.	43.	146	143
	Compost	5.6	5.1	4.3	4.6	24.	23.	39.	39.	115	110
Giza 10	Control	4.1	4.2	4.2	4.2	17.	17.	35.	34.	733.	742.
	Green	4.8	4.4	4.3	4.7	20.	20.	39.	39.	100	984.
	Green	5.6	5.1	4.4	4.9	24.	25.	40.	40.	120	121
	Compost	4.8	4.4	4.1	4.3	20.	19.	38.	38.	924.	871.
Nebraska	Control	4.1	3.7	3.6	4.4	14.	16.	45.	45.	817.	899.
	Green	5.1	4.6	3.8	4.0	19.	18.	51.	51.	120	114
	Green	5.8	5.3	3.6	3.9	21.	20.	53.	52.	134	131
	Compost	4.6	4.2	3.4	3.6	15.	15.	51.	50.	966.	919.
LSD 5%		0.2	0.1	0.1	0.1	1.4	1.4	1.9	1.9	81.1	77.3

Effect of treatments

The results in table 7 cleared that seed contents of; moisture, total protein, total carbohydrates, total soluble sugar and total phenolic significantly differ under the different treatments. All used treatments resulted in significant improve seed contents of; moisture, total protein, total carbohydrates, total soluble sugar and total phenolic in both seasons compared with control. Bean plants that treated with green power gave the highest seed contents of; moisture (14.31 and 14.12 g/100g), total protein

(28.08 and 27.72 g/100 g), total carbohydrates (36.51 and 36.03 g/100 g), total soluble sugar (3.15 and 3.11 g/100 g) and total phenolic (48.64 and 48.01 mg/100 g) in both seasons, respectively followed by green organic magic then compost tea in the three previous traits. On the other side, bean plants under the control treatment had the lowest seed contents of; moisture (12.35 and 12.19 g/100g), total protein (24.23 and 23.91 g/100 g), total carbohydrates (31.50 and 31.09 g/100 g), total soluble sugar (2.72 and 2.68 g/100 g) and total phenolic (41.99 and 41.44 mg/100 g) in both seasons, respectively.

Common bean seed quality was higher under all used organic fertilizers compared with the control. Abd El-Hady and Mohamed (2014) found large increase in nitrogen content of common bean fresh pods (%) under organic fertilizer application than the control. Aslani and Souri (2018) reported that Pod soluble solids, vitamin C and total protein contents of common bean were significantly increased by foliar application of organic-chelate fertilizers.

Seed qualities in this study were higher when common bean sprayed with green power compared with other treatments. This positive effect of green power may be due to their content balanced amount of N, P and K that can enhance seed quality as it showed by several studies before such as; Taha et al., (2016) who revealed seed qualities were increased significantly with increasing rates of potassium fertilizers. Also, Fouda et al., (2017) who showed that the best treatment was NPK 100 % + compost, compared to control enhanced quality parameters (carbohydrates and protein of seed). In addition to green power contain fulvic acid in the study of Rose et al., (2014) fulvic acids played an important role in increasing the vegetative growth and uptake of some mineral elements such as N, K, P, Ca, Fe, Zn and Mg these increase in uptake statues almost increase seed qualities traits.

Effect of the interaction

The obtained results in Table 7 revealed that the three bean cultivars differ in their response to the different treatments in seed contents of; moisture, total protein, total carbohydrates, total soluble sugar and total phenolic in both seasons. In all cases the results confirmed that treated bean plants with green power resulted in a large improve in seed contents of; moisture, total protein, total carbohydrates, total soluble sugar and total phenolic of the three bean cultivars compared with the others treatments as well as control. Nebraska cv that treated with green power had the highest seed contents of; moisture (15.93 and 15.72 g/100g), total protein (31.56 and 31.03 g/100 g), total carbohydrates (40.89 and 40.33 g/100 g), total soluble sugar (3.52 and 3.48 g/100 g) and total phenolic (52.73 and 52.02 mg/100 g) in both seasons, respectively followed by the same cultivar that sprayed with green organic magic in all seed quality traits. On the other side, Giza 10 cv under the control treatment gave the lowest seed contents of; moisture (11.21 and 11.07 g/100g), total

protein (21.31 and 21.04 g/100 g), total carbohydrates (27.70 and 27.35 g/100 g), total soluble sugar (2.39 and 2.36 g/100 g) and total phenolic (38.13 and 37.64 mg/100 g) in both seasons, respectively.

The three tested common bean cultivars differ significant in their chemical traits under the different used fertilizers. The diversity among the three bean cultivars in seed quality traits in the present study were showed before by Ersulo, and Dana (2018) and Kazai et al., (2019). Also, seed qualities traits were higher under all used organic fertilizers compared with the control. Similar results were obtained before by Abd El-Hady and Mohamed (2014) and Aslani and Souri (2018) in common bean.

Table 7: Effect of cultivars, treatments and their interaction on bean seeds chemical properties.

Factors		Moisture %		Total Protein %		Total Carbohydrates %		Soluble sugar %	Total phenolic Content (mg/100g)		
Cultivars		1st Season	2nd Season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Giza 6		13.01	12.84	24.72	24.40	32.14	31.71	2.77	2.73	44.23	43.65
Giza 10		12.32	12.16	23.77	23.46	30.89	30.50	2.66	2.63	41.87	41.33
Nebraska		15.10	14.90	30.53	30.13	39.69	39.16	3.42	3.38	51.34	50.67
LSD 5%		0.48	0.48	1.22	1.20	1.59	1.56	0.14	0.13	1.64	1.62
Treatments											
Control		12.35	12.19	24.23	23.91	31.50	31.09	2.72	2.68	41.99	41.44
Green organic magic		13.81	13.63	27.06	26.70	35.18	34.72	3.03	2.99	46.95	46.34
Green power		14.31	14.12	28.08	27.72	36.51	36.03	3.15	3.11	48.64	48.01
Compost tea		13.44	13.26	25.98	25.64	33.78	33.33	2.91	2.87	45.68	45.08
LSD 5%		0.16	0.16	0.39	0.38	0.50	0.49	0.04	0.04	0.55	0.54
Cultivars	Treat.										
Giza 6	Control	12.17	11.99	23.12	22.78	30.06	29.61	2.59	2.55	41.36	40.76
	Green organic magic	13.21	13.04	25.10	24.78	32.63	32.21	2.81	2.78	44.91	44.33
	Green power	13.96	13.78	26.52	26.18	34.48	34.03	2.97	2.93	47.45	46.84
	Compost tea	12.71	12.55	24.15	23.84	31.40	31.00	2.71	2.67	43.21	42.66
Giza 10	Control	11.21	11.07	21.31	21.04	27.70	27.35	2.39	2.36	38.13	37.64
	Green organic magic	12.71	12.55	24.63	24.31	32.01	31.60	2.76	2.72	43.21	42.66
	Green power	13.04	12.87	25.75	25.41	33.47	33.04	2.89	2.85	44.33	43.75
	Compost tea	12.30	12.14	23.38	23.07	30.39	29.99	2.62	2.59	41.82	41.28
Nebraska	Control	13.67	13.50	28.26	27.92	36.74	36.29	3.17	3.13	46.47	45.91
	Green organic magic	15.51	15.30	31.45	31.03	40.89	40.33	3.52	3.48	52.73	52.02
	Green power	15.93	15.72	31.98	31.56	41.58	41.03	3.58	3.54	54.16	53.44
	Compost tea	15.30	15.09	30.42	30.00	39.54	39.00	3.41	3.36	52.02	51.31
LSD 5%		0.49	0.48	1.16	1.14	1.50	1.48	0.13	0.13	1.65	1.63

Effect of cultivars, treatments and their interaction on common bean rust diseases severity %, disease incidence % and reduction Efficacy % in 2019 and 2020 growing seasons

Effect of cultivar

Data in Table 8 showed that the common bean cultivars differ in their susceptibility or tolerance to rust disease infection. Giza 6 cv. recorded the lowest percentages of disease severity (22.34 and 23.58%) and disease incidence (31.68 and 33.48%) of rust. While, Nebraska cv was the most susceptibility one to rust disease where it showed the highest disease severity percentages (33.76 and 39.13%) and disease incidence (43.57 and 50.05%) of rust in both seasons, respectively. Bean genotypes differ in their tolerance or resistance to different fungi pathogenic. Similar results were shown before by Huang et al., (2002) who screened 505 dry bean (Phaseolus vulgaris) for physiological resistance to grey mold caused by Botrytis cinerea using a detached leaf bioassay technique and found significant differences in the level of physiological resistance were detected among the materials for grey mold. Baraka et al., (2004) concluded that the bean cultivar, Neprasca was less susceptible, Morgan was moderately susceptible and Xera was highly susceptible to ashy stem blight caused by Macrophomina phaseolina. Tadrous et al., (2008) revealed that both Concessa and Amy bean cultivars were entirely free from the rust, thus they are considered as immune cultivars against the disease. Balsas followed by Lexus showed only slight infection consequently, they could be regarded as resistant cultivars. The other cultivars, i.e. Xera and Paulista showed relatively high disease values therefore, they are considered as susceptible cultivars.

Effect of treatments

The effect of different treatments on rust diseases severity (ds), disease incidence (di) and reduction efficacy during the two seasons 2019 and 2020 were shown in (table 8). All the treatments resulted significantly decreased in ds and di of rust during the two seasons under natural infection conditions compared to control. Green power treatment had the best effect in reducing the disease severity and disease incidence. Bean plants that sprayed with green power recorded the lowest disease severity (14.27 and 17.32%) and disease incidence (23.45 and 27.92%) and these reductions in both severity and incidence associated with the highest efficacy of disease reduction (75.54 and 71.81%) in both seasons, respectively. The efficacy of green power in reducing of rust infections in both seasons was followed by green organic magic and compost tea in all disease measurements. On the other side, bean plants under the control treatment recorded the highest disease severity (58.33 and 61.43 %) and disease incidence (71.04 and 75.23%) in the first and second seasons,

respectively. In previous studies, fertilizer was different, especially organic fertilization, a major role in reducing the severity of fungal diseases in many crops. Organic fertilization works to improve plant growth, cells and wound treatment, increasing the plant capacity to bear and resist fungal diseases. In this study, all organized fertilization transactions reduced rustling on bean plants. These results are compatible with those of Martin, (2014) found that organic fertilizers with high microbial populations and nutrients is most appropriate for the production of compost tea with high plant disease suppressive properties. Said et al., (2014) showed that fulvic acid enhances cucumber plant growth and productivity as well as, it has a great role against soil borne and foliar diseases. Kim et al., (2015) reported that compost tea is an organic fertilizer reach in beneficial microorganisms which help in suppressing plant diseases and improving plant health and quality. Reyad (2018) showed great variation among the tested compost tea was effective in reducing the urediospore germination in the lab (21.67% urediospore germination for compost tea). compost tea reducing the disease severity in the greenhouse (23.33% disease severity). Organic fertilizers are a possible alternative to chemical fungicides because of its content of antimicrobial activities (Siddiqui et al., 2008 and Seddigh and Kiani, 2018). There are several mechanisms of microbial action such as microbial competition for nutrients, antibiotic production, antagonistic microbes' natural ability to produce extracellular lytic enzymes (El-Masry, 2002), parasitism and induction of systemic acquired resistance (Pharand et al., 2002) are among the major means by which compost extracts suppress plant pathogenic microorganisms.

Interaction effect

The obtained results in Table 8 indicated that a wide difference in reducing disease severity and incidence of rust in both seasons of this study of the three bean cultivars under different spraying treatments. All used treatment resulted in great reducing in rust severity and incidence in all tested cultivars. Giza 6 cv that sprayed with green organic magic recorded the lowest disease severity (11.59 and 11.69%), disease incidence (16.91 and 17.14%) and the highest efficacy of disease reduction (77.05 and 77.10%) in both seasons, respectively followed by Giza 6 that sprayed with green power in all previous measurements in both seasons. On the Other hand, Giza 10 and Nebraska cvs under the control treatment had the highest disease severity and incidence of rust in both seasons. In this study the three bean cultivars differ in their susceptibility to rust infection under all tested fertilizers and the control. Similar differ were shown before by Huang et al., (2002) on dry bean (Phaseolus vulgaris) against Botrytis cinerea Baraka et al., (2004) on bean cultivar, Neprasca against Macrophomina phaseolina.

Organic fertilizers in this study reduce rust infections in all common bean cultivars compared with controls. Organic fertilizers reach in beneficial microorganisms which help in suppressing plant diseases and improving plant health and quality (Kim et al., 2015). Organic fertilizers are a possible alternative to chemical fungicides because of its content of antimicrobial activities (Seddigh and Kiani, 2018). There are several mechanisms of microbial action such as microbial competition for nutrients, antibiotic production, antagonistic microbes' natural ability to produce extracellular lytic enzymes (El-Masry, 2002), parasitism and induction of systemic acquired resistance (Pharand et al., 2002) are among the major means by which compost extracts suppress plant pathogenic microorganisms.

Table 8: Effect of cultivars, treatments and their interaction on common bean rust diseases severity %, disease incidence % and reduction Efficacy % in 2019 and 2020 growing seasons.

Factors		DS %		DI %		Efficacy %	
Cultivars		1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season
Giza 6		22.34	23.58	31.68	33.48	-	-
Giza 10		29.03	30.25	37.73	40.21	-	-
Nebraska		33.76	39.13	43.57	50.05	-	-
LSD 5%		2.87	3.9	2.97	4.17		
Treatments							
Control		58.33	61.43	71.04	75.23		
Green organic magic		18.2	19.78	25.39	27.53	68.80	67.80
Green power		14.27	17.32	23.45	27.92	75.54	71.81
Compost tea		22.71	25.41	30.75	34.31	61.07	58.64
LSD 5%		2.27	2.42	2.23	2.32		
Cultivars	Treat.						
Giza 6	Control	50.51	51.05	65.12	65.7		
	Green organic magic	11.59	11.69	16.91	17.14	77.05	77.10
	Green power	10.96	13.17	19.51	22.84	78.30	74.20
	Compost tea	16.31	18.41	25.18	28.23	67.71	63.94
Giza 10	Control	62.75	63.12	77.45	80.48		
	Green organic magic	18.02	19.15	23.42	25.51	71.28	69.66
	Green power	14.35	16.32	22.68	25.03	77.13	74.14
	Compost tea	21.02	22.41	27.36	29.84	66.50	64.50
Nebraska	Control	61.73	70.13	70.55	79.53		
	Green organic magic	24.98	28.5	35.84	39.93	59.53	59.36
	Green power	17.51	22.45	28.16	35.89	71.63	67.99
	Compost tea	30.81	35.43	39.71	44.85	50.09	49.48
LSD 5%		3.94	4.18	3.87	4.01		

The relationship between seed yield /fed (kg) and rust diseases severity in 2019 and 2020 seasons.

The results obtained in respect of the regression coefficient (R2) of rust diseases severity with seed yield /fed (kg) (Fig.1) confirmed that rust infection had serious on common bean seed yield /plot (kg) in both season. Seed yield/fed significant negative associated with rust disease severity. The result showed in fig. 1 confirmed that seed yield/fed negative highly associated with rust severity where the R2 was 0.61 and 0.60 with highly significant negative correlation coefficient of -0.81 and -0.77 in both seasons, respectively. the negative correlation between rust severity and seed yield consider clear evidence that seed yield will sharply decreased under the infection of rust. The negative associated between common bean yield and diseases impact were shown by many studies before such as Kim et al., (2015) which they found a negative and significant correlations observed between seed yield /plot (kg) and each of diseases chocolate spot and rust confirm their negative impact on seed yield /plot (kg) of faba bean. Rust disease of common bean led to 25-100% losses depending on stage of infection and the weather conditions (Singh and Schwartz et al., 2010). The wide range of yield loss differ from genotype to another.

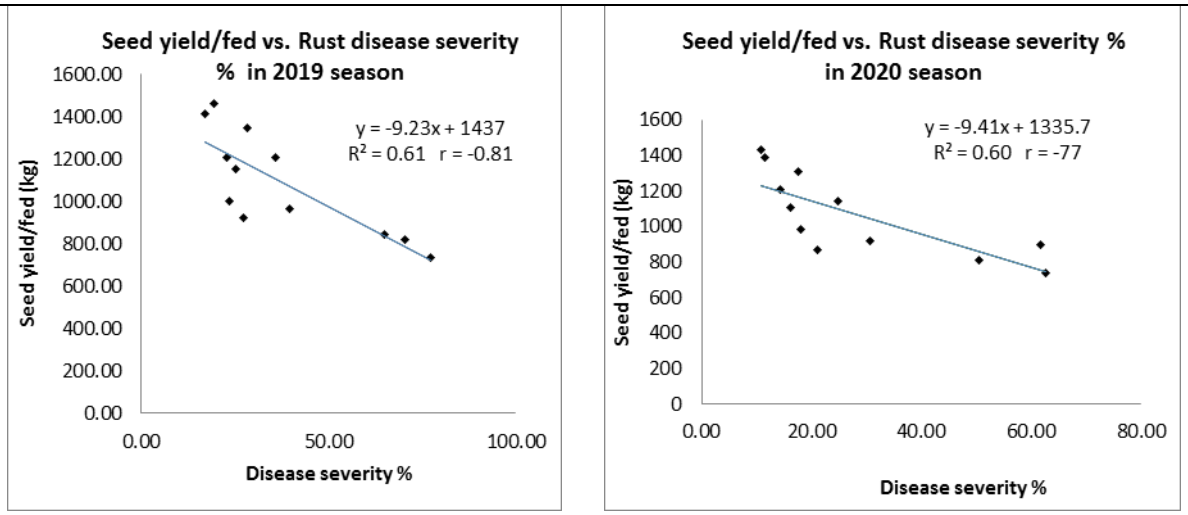

Fig. 1: The relationship between seed yield /fed (kg) and rust diseases severity in 2019 and 2020 seasons.

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