Egyptian Journal of Agronomy
http://agro.journals.ekb.eg/

Agronomic Advancement in Nutrients Management for Sustaining Growth and Crop Contribution in Wheat (*Triticum aestivum* L.)

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CHALLENGES of the coming few years lies in the debate that agriculture can provide the world population with food in need, which are annually exceed. Unprecedented pressure placing on agriculture researchers to achieve food security. Field experiments in Randomized complete block design with four replications were conducted at Agriculture Research Station, Collage of Food and Agriculture Sciences, King Saud University, to evaluate fertilizers management in winter wheat. Treatments included nine combinations of decaying agriculture wastes produced from different organic manures as activators and NPK fertilizers, the treatments were dual replicated two times, one with seed inoculation with nitrogen fixer bacteria (Azotobacter) and phosphate dissolving bacteria (PDB) (*Pseudomonas* sp.) and without seed inoculation. Results obvious, poultry litter manure compost followed by camel and sheep exceeded cow manure in most of the studied characters. Moreover, mixing the three types of composts (5 and 10ton ha^{-1}) with the half dose of chemical fertilizers could compensate the reduce dose, even the reduction equals the half dose and recorded supervision effect in growth contribution, photosynthetic productivity, accumulation, grain yield, yield component parameters and protein percentage. However, insignificant differences were detected due to further increase the doses of the three types of compost. Seed inoculation with biofertilizers enhanced plants to better growth and yield performances. Lastly, it could be concluded that, recycling of agriculture wastes to compost and using it in combination with NPK fertilizers is acceptable option and an effective practice could produce greater yield production with better quality traits and maintain satisfactory high profit.

Keywords: Organic-inorganic fertilizers, Bio-fertilizer, Integrated nutrients, Nutrients balance, Nutrient management.

Introduction

Wheat (*Triticum aestivum* L.) is a major cereal crop belonging to family Gramineae and also is one of the most important food crops. It is a chief constituent of many meals like bread, pastries, cakes, biscuits, cookies and many other local foods. Wheat is classified as moderate salt tolerant and also has flexibility to grow in unfavorable conditions, thus has a brave chance to cultivate successfully under different environment conditions. Also, wheat grains have a large proportion of man's essential nutrients, carbohydrates, protein, fats, minerals and vitamins. Hundred grams of grains contain about 51.8g Carbohydrates, 23.15g of proteins, 9.72g of fats, and 13.301mg of manganese and 13.2g of dietary fiber and also contains a number of different micro and macro nutrients as well as vitamins in trace amount (USDA, 2006).

Growth, yield and yield component characters of most crops are strongly linked with soil health and the rate of fertilizers frequency applied. So, crop productivity can be wisely improved by improving nutrient program, which could mitigate soil nutrient deficiency, compensate the absences of some essential nutrients and create a favorable condition for best growth (Torstensson et al., 2006; Wang et al., 2009; Xu et al., 2013).

Earlier, several researches concluded that continuous crop sowing in intensive cropping

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Received 24/11/2019; Accepted 15/12/2019
DOI: 10.21608/agro.2019.20045.1196

system without replenishing the removal soil nutrients would certainly deplete soil health, decrease natural resources and reduce nutrient use efficiency (Powell et al., 1996; Raun & Johnson, 1999; El-Sharkawi, 2012).

Achieving higher yield per unit area is a bold challenge facing researchers, agricultural specialists and farmers worldwide, also is the main option of solving highly critical problems of alleviation poverty. Therefore, improving agronomic approaches, which have drastic effect on crop growth, improve soil health and yield production are urgently need (Ali, 2010), among different agronomic practices, selecting fertilization program which had facilities to cover crop requirements, generate some improvements in soil characteristics, and decrease the large amount of fertilizers used is necessary (Yadav & Meena, 2009; Kacar & Katkat, 2009; Yolcu et al., 2011; Suge et al., 2011; Gudugi, 2013; Recep İrfan et al., 2015; Ghulam et al., 2015; Selim, 2018).

In the same domain, several researches reported that, applying organic manures after crop harvest is a bright option not only as a source of macro and micronutrients, but also as soil amendment, and also as a tool could improve soil quality, restore productivity and upgrade soil class through advancing soil physiochemical and biological properties (Adeoye et al., 2011; Siavoshi et al., 2011; Rahmann et al., 2013).

Bulk of literature highlighted that, long term use of organic and inorganic fertilizers in combination with biofertilizers is an effective option helps farmer to get maximum benefits from their investments as compared to the sole application of synthetic fertilizers (Sarwar et al., 2007; Sarwar et al., 2008; Abbasi & Yousra, 2012; Bairwa et al., 2013).

Despite, several studies indicated that, the residual effect of bioorganic farming system may double the yield of subsequent cereal crop (Ghosh, 1980). The studies of Prasad et al. (2002), Alam et al. (2005), Sarwar et al. (2007, 2008), Tirol-Padre (2007), Khoshgoftarmanesh et al. (2010), Yu (2014), Rahmann et al. (2016) and Selim (2018), suggested that bioorganic farming system is an important tool for improving the nutrient reserve in soils; restoring soil health and may be became the most effective management practice advanced soil biological and physio-chemical properties, which are vital component in assessing yield and yield contribution of existing and succeeding crops.

Based on the previous studies, the present study was conducted to evaluate the performance of the combination of inorganic and organic compost produced from decaying agriculture wastes with the help of different organic manure as activators along with biofertilizers as compared with the application of each sole in wheat grown under low input condition. The work was done through the altogether objectives of the project Number (12-AGR3110-02), funded by King Abdul-Aziz City for Science and Technology.

Materials and Methods

Description the experimental site and the experimental design

In Randomized complete block design (RCBD) with four replications, field experiments were conducted during the two successive winter seasons of 2014/2015 and 2015/2016, respectively, at Agriculture Research Station, Collage of Food and Agriculture Sciences, King Saud University, South Riyadh region, Saudi Arabia (24.42^o N latitude and 46.44^o E Longitudes, Altitude 600m). Monthly maximum, minimum, mean temperature and relative humidity during the time of the experiments are presented in (Table A).

TABLE A. Monthly maximum, minimum, mean temperature, relative humidity and total amount of rainfall during the experiments time.

Month	Temperature (^{o}C)			Relative humidity (%)	Total amount of rainfall (mm)
	Maximum	Minimum	Mean		
November	29.42	12.80	21.11	28.7	0.00
December	20.28	8.04	14.16	47.4	10.67
January	20.37	6.52	13.45	32.5	8.12
February	21.25	8.53	14.89	18.9	4.22
March	23.14	9.54	16.34	24.5	4.67
April	27.38	14.04	20.71	16.8	5.59
May	34.69	18.96	26.83	10.7	0.25

Data are mean of two years' experiments.

Treatment details

Nine treatments in total consist of 1. Recommended dose of NPK fertilizers, T1-(control), 2. Sole application of each type of the three types of compost at the rate of (5ton ha-^{1}, T2, T3 and T4), 3. Combination of the mixture of the three types of prepared compost at the rate of 5ton ha^{-1} and 10ton ha^{-1} in the presence of half dose of the recommended dose of NPK (T5 and T6), as well as mixture of the three types of compost at the rates of (10, 15 and 20ton ha^{-1}) (T7, T8 and T9). All these treatments were replicated dual, one with seed inoculation with multi-strain bacteria (biofertilizers), whereas the others were sown without seed inoculation. The details of the treatments are given in Table 1.

TABLE 1. Treatment details.

Treatment No.	Treatment details
T1	Recommended dose of chemical fertilizers NPK (control) (kgha^{-1}).
T2	5ton ha^{-1} cow manure compost.
T3	5ton ha^{-1} poultry litter manure compost.
T4	5ton ha^{-1} sheep and camel manure compost.
T5	50% NPK fertilizers + 5ton ha^{-1} mixture of the three types of compost.
T6	50% NPK fertilizers + 10ton ha^{-1} mixture of the three types of compost.
T7	Mixture of the three types of compost by the rate of 10ton ha^{-1}.
T8	Mixture of the three types of compost by the rate of 15ton ha-^{1}.
T9	Mixture of the three types of compost by the rate of 20ton ha-^{1}.

Preparing decaying compost

Different agricultural wastes scattered around the area of the experimental site were collected and divided into three heaps equal in size, each one is (5x 10x 1.5m). Each heap mixed with equal amount of one of the three types of manure as activators *i.e.,* poultry litter, cow and mixture of sheep and camel manures. All recommendation for producing a good quality compost were followed *viz.,* every 15 days, heaps were mechanically turned upside down, satisfactory temperature was considered by adding water if necessary to keep the moisture content inside the heaps at the optimum level, injection heaps with a mixture contained 1X 10^{8} of each of *Streptomycs aurefaciens, Trichoderma viridie, T. harzianum, Bacillus subtilis, B. licheniformis* (1L/ton), to speed up the process of decomposition and enrich the compost quality. Nearly, after 120 days good quality compost was produced brown to dark brown humidified, more stable in form and valuable source of plant nutrients. Chemical and physical composition of the three types of compost at maturity as well as the mixture of the three types were also analyzed, results are presented in Tables 2 and 3.

TABLE 2. Chemical and physical composition of the three types of composts.

Properties	Values
Organic carbon %	14
E.C. dS/ m^{-1}	2.47
pH	7.76
Total N %	0.60
Available P (ppm)	101.0
C/N ratio	21.80

Field preparation and sowing

Seed bed was prepared before sowing as recommended; field was ploughed with tractor followed by a thorough harrowing to break the clods. Then properly leveled and divided into plots, each plot consisted of 8 lines 20cm apart, 3m in length, total experimental unit area was 4.80m^{2}. The plots were isolated by borders of 1.5m in width from each side. Chemical fertilizers as per the treatment details in (Table 1) were applied by the recommended dose *viz.,* 150kg N/ha^{-1}, 150kg P_2O_5/ha^{-1} and 60kg K_2O/ha^{-1}. Considering that nitrogen was applied two times the first dose after 21 days from sowing and the second two weeks later. Also, as per the treatment details, compost (organic manures) was applied according to the treatments details during the final ploughing and leveling the ground. The wheat crop (cv. Yacoora) was drilled on 8 November and 11 November in the first and second seasons, respectively. All cultural practices were followed according to the conventional production practices followed by farmers at Riyadh region.

Soil analyses

Before the commencement of the field experiments and during soil preparation five soil samples were taken across the field to a depth of 30 cm and bulked for laboratory analyses. Samples were stored in polythene bags to prevent significant changes e.g., degradation or volatilization. In the laboratory, particle size distribution was measured using the rapid method, and define soil texture, which refers to the relative proportions of clay, silt, and sand on a <2-mm basis. Soil pH was measured in 1:5 soil: water suspension, with a calibrated combination electrode/digital pH meter (procedure 4I1a1a1). After measuring a number of samples, pH meter was calibrated with buffer solutions of pH 4.01 and 7.00. EC (dS m^{-1}) in soil suspension was also measured using an electronic bridge according to the methods described by Cottenie et al. (1982) and Burt (2004). Saturation percentage (%), Field capacity (%) and Wilting point (%) were determined by the methods described by Cottenie et al. (1982) and Burt (2004). Macro-nutrients i.e., N was measured by Microkjeldahl method as described by A DAS (1981); P was measured by the methods described by Chapman & Pratt (1978), K and Ca were determined using flame photometer (Jenway PFP7). Micro-nutrients *viz.,* Iron (Fe), Manganese (Mn) and Zinc (Zn) were also determined by Atomic Absorption Spectrophotometer (Zesiss PMQ3). Results of physio-chemical properties of the experimental soil site are presented in Table 4.

Water irrigation

Water irrigation was applied as recommended, through line pipe provide with meter gages for measuring the same amount of water applied for each subplot. Water samples were taken five times for measuring water analyses as described by Velthorst (1996), samples were measured immediately upon arrival at the laboratory in order to maintain optimal preservation of sample, pH was measured using calibrated combination electrode/digital pH meter (procedure 4I1a1a1), water electrical conductivity (EC) was measured using an electronic bridge and total dissolved salts (TDS). Soluble cations and soluble anions (meq/L) as well as total NPK (ppm) were also measured according to the methods described by American Public Health Association (APHA, 1992). Data obtained are presented in Table 5.

TABLE 3. Chemical and physical composition of the mixture of the three types of composts at maturity.

Property	Poultry litter	Cow manure	Camel and sheep manure
Organic carbon (%)	24.16	26.90	27.24
E.C. dS/ m^{-1}	3.52	3.79	3.91
pH	7.11	7.27	7.32
O.M	41.65	42.98	46.96
Moisture (%)	20.20	25.50	22.83
Total N (%)	0.65	0.55	0.97
Available P (ppm)	112.06	98.62	100.14
C/N ratio	20.86	21.62	20.10

TABLE 4. Physio-chemical properties of the experimental soil site.

Particulars	Values	Available macro. and micro nutrients (ppm)	
pH (soil paste 1:5)	7.86	Particulars	Values
Saturation percentage (%)	29.70	N	35.40
EC (dS m^{-1})	3.88	P	14.80
Organic matter (%)	0.46	K	243.50
CaCO3 (%)	29.42	Fe	3.27
Field capacity (%)	16.30	Mn	2.44
Wilting point (%)	7.67	Zn	6.07
Sand (%)	57.92	Cu	0.70
Silt (%)	27.20		
Clay (%)	14.88		
Texture	Sandy loam		

TABLE 5. Chemical and physical analyses of the irrigation water.

Chemical properties		Soluble cations (meq/L^{-1})		Soluble anions (meq/L^{-1})		Macronutrients (ppm)	
Item	Value	Item	Value	Item	Value	Item	Value
pH	7.10	Ca	6.30	HCO_3	2.40	N	10.50
		Mg	1.75	Cl	4.85		
EC(dS/m^{-1})	1.45	Na	7.35	SO_4^{--}	9.24	P	9.23
O.M %	0.02	K	0.44	HCO_3	2.40	K	17.00

Biometric observations

Vegetative growth characters

During the growing season after 70 and 100 days from sowing a samples were taken from square meter for each sub-plot at random for recording different biometric observations *viz.,* main stem length (cm) using steel meter rule from soil level to flag leaf, number of tillers, leaf area in cm^2 (length x width) and total dry matter g/m^2.

Leaf pigment content

Photosynthesis pigment contents basis of blade area of the flag leaf (mg/dm^2) were determined calorimetrically in the first season after 60 days from sowing and in the second season at two times after 70 and 90 days from sowing *viz.,* (Chl. *a*; Chl. *b*; Chl. *a* + *b* and Cartooned). A sample of flag leaf was taken from each sub plots, weighted and ground with the help of mortar and pestle with 10ml of 80per cent acetone. The homogenate was centrifuged at 800rpm for 15min. The supernatant was saved. The residue was re-extracted with 10 ml of 80 per cent acetone. The supernatant was saved and the absorbance values were read at 645nm and 663nm in a UV-Spectrophotometer as described by Von Wettstein (1957). The chlorophyll *a*, chlorophyll *b* and total chlorophyll contents were estimated and expressed in mg/g fresh weight basis.

Chlorophyll a= (0.0127) x (OD 663) – (0.00269) x (OD 645)

Chlorophyll b= (0.0029) x (OD 645) – (0.00488) x (OD 663)

Total chlorophyll= (0.0202) x (OD 645) + (0.00802) x (OD 663)

Carotenoid

The same plant extract used for chlorophyll, also used in estimation carotenoid content. The acetone extract was read at 480 nm in UV-Spectrophotometer. The carotenoid content was calculated by using the formula described by Kirk & Allen (1965), as follows:

Carotenoid = (OD 480) - (0.114) x (OD 663) - (0.638) x (OD 645).

Yield and yield component characteristics

At harvest time, two central rows in each sub-plots were harvested for determining grain yield per unit area (kg/m^2), then extrapolated to a yield per hectare (ton/ha.), and also biological yield kg/m^2 was determined and extrapolated to biological yield (ton/ha.). A sub sample of ten spikes were randomly taken for determining the yield component characters *viz.,* spike length (cm), number of spike/m^2, number of grains/spike, grain weight/spike (g), 1000 grains weight (g) and grain yield (ton/ha.).

Statistical design and analysis

The experimental design was complete randomized block design with 4 replications. Data obtained were subjected to statistical analysis according to the methods described by Gomez & Gomez (1984). Means were compared using Fishers protecting least significant difference (LSD) method at 0.05 level of probability.

Results and Discussion

Generally, it is notable that values of most growth parameters of the second season are higher than those of the first season. Such effect might have been due to the effect the preceding crop and plant residue remained in soil after harvested, beside a part of unused fertilizers are left in soil, particularly similar treatments are placed in the same area in the two consecutive seasons.

Vegetative growth characters

Main stem length

Analysis of variance of the data of the two seasons exhibited that the main stem length of wheat plants at two growth stages in 2014/2015 and 2015/2016 seasons were significantly affected by managing fertilization treatments (Tales 6 and 7). The data showed that, values of the main stem length ranged from 53.40cm. to 84.49cm. and from

63.03cm. to 91.5cm in the first and second stages in the first season and from 69.84cm. to 83.63cm. and from 87.84cm. to 96.34cm. in the first and second stages in the second season, respectively. Over all treatments the highest values of the main stem length 95.59cm and 97.52cm were recorded in the plots received mixture of the three types of compost by the rate of 10ton ha^{-1} (T8) in the presence of seed inoculation. Whereas, the lowest values of the main stem length 60.28cm. and 85.80 cm. were produced in the sole application of 5ton ha^{-1} of cow manure compost and non-inoculated seeds in the first and second seasons, respectively. Such results worthy indicated the importance of seed inoculation (biofertilizers) in increasing plant growth characters, similar findings regarding the effect of integrated nutrient management on main stem length was also reported by Khan et al. (2007), Rahman et al. (2008) and Islam et al. (2010) and Soleimanzadeh & Gooshchi (2013).

TABLE 6. Influence of agronomic advancement in nutrients management on growth parameters of wheat (*Triticum aestivum* L.) in winter season of 2014/2015.

Treatments		Main stem length (cm)		No. of productive tillers		Leaf area (cm^2)		Total dry weight (g/ m^2)	
Integrated nutrient	**Seed* inoculation**	**70 days**	**100 days**	**70 days**	**100 days**	**70 days**	**100 days**	**70 days**	**100 days**
T1	+	58.24	68.11	380	443	29.89	31.73	334.18	418.74
	0	53.82	65.85	335	382	27.35	30.89	325.42	454.33
	Mean	56.03	66.98	357.5	412.5	28.62	31.31	329.80	436.54
T2	+	56.84	66.41	468	466	30.10	26.27	321.55	352.76
	0	54.66	60.28	456	373	33.55	23.33	310.25	347.04
	Mean	55.75	63.35	462.0	419.5	29.11	24.80	315.90	349.90
T3	+	58.75	68.59	475	517	31.72	30.89	315.75	499.18
	0	56.67	65.37	398	447	30.89	33.53	309.56	483.12
	Mean	57.71	66.98	436.5	482.0	33.53	32.21	312.66	491.15
T4	+	54.25	67.77	436	484	32.21	29.88	289.77	494.55
	0	52.55	65.44	354	423	26.27	29.47	276.42	459.55
	Mean	53.40	66.61	395.0	453.5	23.33	29.68	283.10	477.05
T5	+	65.67	68.84	498	544	24.80	34.55	328.74	599.82
	0	63.47	65.65	487	443	29.88	32.90	317.79	595.25
	Mean	64.57	67.25	492.5	493.5	29.47	33.73	323.27	597.54
T6	+	67.45	77.89	548	583	29.68	33.94	346.11	654.33
	0	60.92	72.59	486	496	31.73	32.88	338.33	618.74
	Mean	64.19	75.24	517.0	539.5	28.10	33.41	342.23	636.54
T7	+	65.43	86.17	487	522	29.92	34.29	368.37	544.86
	0	64.25	84.90	480	518	33.74	31.67	358.98	495.53
	Mean	64.84	85.54	483.5	519.5	32.44	32.98	363.68	520.20
T8	+	89.47	95.59	539	540	33.09	34.44	398.65	585.77
	0	79.50	87.54	523	536	34.29	32.31	387.45	568.43
	Mean	84.49	91.57	531.0	538	31.67	33.38	393.05	577.10
T9	+	88.86	94.21	536	556	32.98	33.89	367.45	598.43
	0	78.55	82.54	500	522	34.44	32.66	362.57	598.55
	Mean	83.71	88.38	518.0	539.0	32.31	33.28	365.01	596.99
Inoculation (+)		67.22	76.84	485.2	517.22	33.29	33.89	341.17	512.32
Non- inoculation (-)		62.71	72.24	446.6	456.67	31.20	32.66	331.86	505.57
LSD for									
Inoculation		10.4	5.9	10.5	14.9	0.66	1.16	11.9	16.52
Nutrient management		3.6	3.4	16.4	16.8	1.44	1.37	8.22	4.62
Interactions		2.2	1.2	11.2	20.3	1.32	1.22	10.14	13.74

TABLE 7. Influence of agronomic advancement in nutrients management on growth parameters of wheat (*Triticum aestivum* L.) in winter season of 2015/2016.

Treatments		Main stem length (cm)		No. of productive tillers		Leaf area (cm^2)		Total dry weight (g/m^2)	
Integrated nutrient	Seed* inoculation	70 days	100 days	70 days	100 days	70 days	100 days	70 days	100 days
	+	72.80	91.92	421.0	482.0	28.25	36.78	499.56	865.28
T1	0	69.70	87.90	410.0	440.0	26.31	34.86	485.17	759.44
	Mean	71.25	89.91	415.5	461.0	27.28	35.82	492.37	812.36
	+	70.56	89.88	452.0	520.0	30.29	32.84	475.66	764.64
T2	0	69.12	85.80	422.0	444.0	27.92	30.73	469.96	876.66
	Mean	69.84	87.84	437.0	482.0	29.11	31.79	472.81	820.65
	+	75.93	92.70	462.0	494.0	30.58	33.99	483.41	899.92
T3	0	75.50	92.00	447.0	470.0	28.88	32.42	476.34	885.54
	Mean	75.72	92.35	454.5	482.0	29.73	33.21	479.88	892.73
	+	75.44	95.57	466.0	512.0	31.85	32.69	484.77	826.66
T4	0	73.25	94.75	453.0	492.0	30.77	31.33	479.86	926.84
	Mean	73.35	95.24	459.5	502.0	31.31	32.01	482.32	876.75
	+	76.25	95.62	482.0	544.0	33.28	41.71	533.93	999.55
T5	0	74.22	94.91	443.0	493.8	29.79	39.78	517.28	879.72
	Mean	75.24	95.27	462.5	518.9	31.54	40.77	525.61	939.64
	+	83.22	95.88	490.0	560.0	35.33	40.71	555.94	1048.44
T6	0	77.20	95.00	440.0	533.0	31.55	37.78	547.88	987.84
	Mean	80.21	95.44	465.0	546.5	33.44	39.25	551.91	1018.14
	+	84.19	96.74	462.0	570.0	31.86	38.92	488.65	976.44
T7	0	82.51	94.88	445.0	522.0	29.44	37.85	481.87	877.66
	Mean	83.35	95.81	453.5	546.0	30.65	38.39	485.26	927.05
	+	84.21	97.52	422.0	556.0	32.22	38.42	477.86	979.94
T8	0	81.75	95.16	416.0	539.0	30.41	38.39	469.22	878.44
	Mean	82.98	96.34	419.0	547.5	31.32	38.41	473.54	929.19
	+	85.12	96.81	434.0	550.0	32.50	38.41	492.71	986.64
T9	0	82.14	95.20	430.0	546.0	30.77	38.27	486.75	875.78
	Mean	83.63	96.00	432.0	548.0	31.64	38.34	489.73	931.21
Inoculation (+)		78.64	94.74	454.5	527.3	31.80	36.73	499.17	927.50
Non- inoculation (-)		76.15	92.51	434.0	502.4	29.54	34.92	490.48	883.10
LSD for									
Inoculation		1.97	2.10	4.80	14.85	1.16	1.75	6.55	14.45
Nutrient management		1.46	1.37	5.10	13.60	0.98	0.44	2.37	1.99
Interactions		0.79	0.92	3.74	10.22	1.12	1.24	4.78	6.15

Number of productive tillers/m²

According to the data registered in Tables 6 and 7, there are significant differences among the treatments concerning the effect of managing nutrient supplies in number of productive tillers/ m^2. The data showed that, plants grown in plots received the mixture of the three types of compost at the rate of 10ton ha^{-1} + 50% of the recommended dose of NPK (T6) recorded the highest number of productive tillers/m^2 583 and 560.0 in the first and second seasons, respectively, followed by the plants received the mixture of the three types of compost at the rate of 20ton ha^{-1} (T9), recorded number of productive tillers/m^2

estimated 539.0 and 548.0, in the first and second seasons, respectively. However, the minimum number of tillers/m^{-2} 412.5 and 461.0 were observed in positive control treatment (T1), in the first and second seasons, respectively. Likewise, there was a significant positive effect in number of tillers/m^{-2} due to the third order interactions of integrated biodegraded compost in combination with chemical fertilizers and seed inoculation as compared to non-inoculated seeds. These results corroborate the findings of Hussain et al. (2004, 2008), Devi et al. (2011), Nawab et al. (2011) and Yadav et al. (2017).

Leaf area (cm^2)

Data in Tables 6 and 7, also indicated that, various levels of nutrients applied through NPK fertilizers alone and their combination with organic compost and bio-fertilizers influenced the Leaf area (cm^2). Application of inorganic fertilizers NPK along with organic compost significantly increased the Leaf area (cm^2) as compared with sole application of the recommended dose of NPK (positive control) or single application of organic compost. Generally, integrated nutrient management practices of organic compost at the rates of 5 and 10ton ha^{-1} in combination with the half dose of inorganic fertilizers NPK recorded the highest values of leaf area cm^2 33.73 and 33.41cm^2 in the first season and 40.77cm^2 and 39.25cm^2 in the second season, respectively. However, the lowest values were recorded in the plots received 5 ton ha^{-1} of cow manure compost 24.80cm^2 and 31.79cm^2 in the first and second seasons, respectively. Data in the same tables also indicated that, overall treatments, seed inoculation surpassed that non–inoculated seeds and recorded the highest values of leaf area (cm^2). The present results are in harmony with the findings of Khan et al. (2007) and Soleimanzadeh & Gooshchi (2013).

Total dry weight (g/m^2)

Among the growth parameters, total dry weight is closely linked to yield contribution, the data on total dry weight g/m^2 listed in Tables 6 and 7, indicated that wheat plants grown in two successive winter season of 2014/2015 and 2015/2016 in two growth periods were significantly affected by various nutrient treatments. In general, application of integrated nutrient management practices of the half dose of NPK associated with organic compost at the rate of 5ton ha^{-1} and 10ton ha^{-1} surpassed the all treatments and recorded the highest values of total dry weight g/m^2 597.54, 636.54 and 939.64, 1018.14 in the first and second seasons, respectively. Furthermore, increased the rate of application of the mixture of the three types of compost, gradually increased the total dry weight in both seasons. In general, gradual increase in total dry weight g/m^2 due to the application of the mixture of the three types of compost at the rate of 10ton ha^{-1} (T7) estimated 520.20 and 927.05 g/m^2, followed by application of the mixture of the three types of compost at the rate of 15ton ha^{-1} recorded 577.10 and 929.19g/m^2 and lastly application the high rate of the mixture of the three types of compost at the rate of 20ton ha^{-1} produced 596.99 and 931.21g/m^2 in the first and second seasons, respectively. Such effect was early expected since the same treatments were mostly affected significantly on most of biometric observations in both growth periods in both seasons. In the same Tables also can be noticed that, a significant positive difference in total dry weight due to the interaction between integrated nutrient management of organic compost and inorganic fertilizers of NPK in the presence of seed inoculation with biofertilizers as compared with non-inoculation. Such effect might be due to the reason of increasing nitrogen fixation, enhancing the mobility and availability of fixed nutrients, then create a favorable condition to plant absorption, nutrients up take, translocation and ultimately increase biomass yield. The experiments of Sumit & Chandel (2005) and Murugesa Boopathi et al. (2010) explained that seed inoculation improved the total dry weight by enhanced translocation of nutrients and water from source to sink. Similar findings of increased biomass due to integrated nutrient management were also regarded by Islam et al. (2010).

Photosynthetic pigments content

Chlorophyll is the molecule that absorbs sunlight and uses its energy to synthesis carbohydrates from CO_2 and water. Accordingly, chlorophyll plays an important role in the ATP generation and prevention of essential plant constituents. In this domain, Rajasekaran et al. (2015), suggested that, the presence or absence of chlorophyll in plant greatly affects the production of secondary metabolites and other essential plant constituents.

Data registered in Tables 8 and 9, indicated that significant differences on the concentration of chlorophylls (chlorophyll *a* and chlorophyll *b*) and carotenoids in the leaf tissues of wheat plants (mg/dm^2), after 60 days from sowing in the first season and after 70 and 90 days from sowing in the second season were observed. The same treatments which previously recorded the highest values of the most of growth parameters also recorded the highest values of chlorophyll *a* + chlorophyll *b* and carotenoids in both seasons. In the first season application of the mixture of the three types of compost at the rate of 10ton ha^{-1} + 50% of the recommended dose of NPK (T6) recorded the highest values of photosynthetic pigments content i.e., chlorophyll *a* (2.30), chlorophyll *b* (1.10) , Chal. *a+b* (3.45) and carotenoids (1.45), followed by the treatment of application of the mixture of the three types of compost at the rate of 5ton ha^{-1} + 50% of the recommended dose of NPK (T5), recorded 2.20, 1.10 , 3.30 and 1.23 for chlorophyll *a*, chlorophyll *b*, Chal. *a+b* and carotenoids, respectively, as compared to the positive control treatment which recorded 1.85,1.05,2.90 and 1.08 for chlorophyll *a*, chlorophyll *b*, Chal. a+b and carotenoids, respectively. In the same table, the lowest values were recorded in application of cow manure compost at the rate of 5ton ha^{-1} recorded 1.30, 0.85, 2.30 and 1.09 for chlorophyll *a*, chlorophyll *b*, Chal. *a+b* and carotenoids, respectively. Regarding the sole application of organic compost, application poultry litter manure at the rate of 5ton ha^{-1} exceeded cow and camel and sheep manures and recorded the highest values of the leaf pigments content, in addition the mixture of the three types of compost at the rate of 15ton ha^{-1} (T8), recorded the highest values of chlorophyll *a* + chlorophyll *b* and carotenoids 2.40, 1.20, 3.60 and 2.21, respectively. In the second season in both growth periods data showed nearly the same trend, but the values were higher than the first season (Table 9). Data on photosynthesis pigments content for the both seasons also obvious that, application integrated nutrient management in combination with seed inoculation had a significant difference in most of photosynthesis pigment parameters. For example, plants received integrated nutrient management of organic manure compost sole or in combination of inorganic fertilizers in the presence of seed inoculation recorded the higher values of leaf pigments content (chlorophylls *a, b* and carotenoids) as compared to the same treatment without seed inoculation. Such effect can be early predicted the expected yield, because the pigments content particularly the ratio of chlorophyll *a*/ chlorophyll *b*, is known as an indirect indicator of the energetic of LHC II system (Light Harvesting Complex II) that is controlling the first stage of solar energy conversion into its chemical form that influenced in the accumulation process and metabolisms. Sheteawi & Tawfik (2007), concluded that bioorganic farming system exhibited higher values of photosynthesis productivity than traditional fertilization scheme plants.The present findings are in agreement with those obtained by Kate et al. (2005) on potato, Abd-El-Gawad (2006) on *Vicia faba*, Qurbanly et al. (2006) on rice, Chandrasekar et al. (2005) on white millet and wheat leaves, Salem & AL-Zayadneh (2010) on potato plants, Shams (2012) on kohlrabi and Larimi et al. (2014) on sweet basil. They reported a positive correlation between the nutrients management and the leaf pigment contents of leaves.

Yield, yield component characteristics and protein percentage

Yield is a complex agronomic parameter affected by many factors, among other factors, the response to fertilizers was more marked than the others, plants received their requirements have a significant input in economic yield values than that not received the nutrients need, because fertilizers has a potential role in metabolic products. Despite, this knowledge is well known long ago, recently a debate regarding the effect of organic manures, some investigators stated that application of organic manure compost have positive effects on yield trends, i.e. Yadav et al. (2000) and Dawe et al. (2003), whereas others suggested that no significant effects on yield trends due to application organic manures (Ladha et al., 2003; Duxbury, 2001). The results of the present study presented in Tables 10 and 11, showed that positive and significant effect, due to integrated nutrient management were observed in yield and yield component characters, plants received mixture of the three types of compost by the rate of 10ton ha^{-1} + half dose of recommended NPK (T6), followed by that received the mixture of the three types of compost by the rate of 5ton ha^{-1} + half dose of recommended NPK (T5), recorded the highest values of spike length, recorded the highest values of spike length, cm 10.68-10.50; number of grain per spike; 44.25-43.70; 1000 grain weight, g 52.73-50.03; grain yield, ton ha^{-1} 6.33-5.58; Biological yield, kg m^2 1.878-1.660; harvest 33.81-32.57 and protein percentage 10.48-11.07 in the first season. In the second season, although the same trend was observed, the values of yield and yield component characters were higher than the first season, i.e., spike length, 10.68–10.50cm; number of grain per spike 46.60–45.10; 1000 grain weight 49.81–49.38g; grain yield 6.31–6.18ton ha^{-1}; Biological yield 1.94–1.90kg m^2; 32.57–32.49 harvest index and protein percentage 11.00–10.69. Such effect may be due to such treatments provide plant with satisfactory condition, which are favorable to plant growth and ultimately increase yield as well as yield component characters. Such effect may be also due to both fertilizers source organic and inorganic word together to offer a good option and economic choice to supply plants with sufficient amount of essential nutrient required for producing higher growth vigor for long time and can create favorable condition for producing higher yield performance (Khan et al., 2010; Suge et al., 2011; Ali et al., 2012; Dejene & Lemlem, 2012; Laekemariam & Gidago, 2012; Ghulam et al., 2015; Selim, 2018). Whereas, others suggested that, the advantages are thought mainly due to the role of the combinations of both sources of fertilizer in improving physiochemical soil properties.

TABLE 8. Influence of agronomic advancement in nutrients management on photosynthetic pigments content in Wheat (*Triticum aestivum* L.) leaves in winter season of 2014/2015.

Integrated nutrient	Seed inoculation	Chl. *a*	Chl. *b*	Chl. *a+b*	Carotenoids	Chl. *a/b*	Chl. *a+b/* carotenoids
	+	1.90	1.10	3.00	1.26	1.90	2.54
T1	0	1.80	1.00	2.80	0.90	2.00	3.44
	Mean	1.85	1.05	2.90	1.08	1.95	2.99
	+	1.40	1.00	2.50	1.17	1.50	2.14
T2	0	1.20	0.70	2.10	1.00	2.00	2.10
	Mean	1.30	0.85	2.30	1.09	1.75	2.12
	+	1.70	1.10	2.80	1.08	1.55	2.60
T3	0	1.40	0.90	2.30	1.00	1.56	2.30
	Mean	1.55	1.00	2.55	1.04	1.56	2.45
	+	1.50	1.00	2.40	1.23	1.40	1.95
T4	0	1.40	0.70	1.90	1.20	1.71	1.58
	Mean	1.45	0.85	2.15	1.22	1.56	1.77
	+	2.30	1.20	3.50	1.23	1.90	2.36
T5	0	2.10	1.00	3.10	1.22	2.00	2.21
	Mean	2.20	1.10	3.30	1.23	1.95	2.29
	+	2.40	1.20	3.60	1.10	1.75	3.00
T6	0	2..20	1.00	3.30	1.80	1.90	1.61
	Mean	2.30	1.10	3.45	1.45	1.83	2.31
	+	2.30	1.20	3.50	1.13	1.92	3.10
T7	0	1.93	1.10	3.03	1.20	1.75	2.53
	Mean	2.12	1.15	3.27	1.17	1.84	2.82
	+	2.60	1.40	4.00	1.21	1.86	1.65
T8	0	2.20	1.00	3.20	1.20	2.20	1.33
	Mean	2.40	1.20	3.60	1.21	2.03	1.49
	+	2.40	1.00	3.40	1.15	2.40	1.48
T9	0	2.10	0.90	3.00	1.23	2.33	1.22
	Mean	2.25	0.95	3.20	1.19	2.37	1.35
General means							
Inoculation (+)		2.00	1.11	2.70	1.17	1.80	2.31
Non- inoculation (-)		1.77	0.91	2.35	1.19	1.94	2.41
LSD for							
Fertilization treatments		0.15	0.10	0.18	0.13	0.12	0.11
Interaction		0.20	NS	0.21	NS	0.11	0.90
Inoculation		0.12	NS	0.16	NS	0.15	0.15

TABLE 9. Influence of agronomic advancement in nutrients management on photosynthetic pigments content in Wheat (*Triticum aestivum* L.) leaves in winter season of 2015/2016.

Integrated nutrient	Seed inoculation	70 days after sowing				90 days after sowing			
		Chl. *a*	Chl. *b*	Chl. *a+b*	Carotenoids	Chl. *a*	Chl. *b*	Chl. *a+b*	Carotenoids
	+	4.95	3.50	8.45	3.38	6.16	4.09	10.25	3.96
T1	0	3.67	2.48	6.15	2.67	5.77	3.44	9.31	2.84
	Mean	4.31	2.99	7.30	3.03	5.97	3.77	9.78	3.40
	+	2.77	2.19	4.96	2.88	4.17	2.69	6.86	3.30
T2	0	2.45	1.98	4.43	2.25	3.85	2.75	6.60	2.19
	Mean	2.61	2.09	4.70	2.57	4.01	2.72	6.73	2.75
	+	3.42	2.50	5.92	2.34	4.26	2.92	7.18	2.75
T3	0	2.97	2.10	5.07	2.03	3.70	2.45	6.15	2.38
	Mean	3.20	2.30	5.50	2.19	3.98	2.59	6.67	2.57
	+	3.57	2.52	6.09	2.44	4.45	2.94	7.39	2.86
T4	0	3.44	2.35	5.79	2.35	4.28	2.75	7.03	2.75
	Mean	3.51	2.44	5.94	2.40	4.27	2.85	7.21	2.81
	+	5.41	4.21	9.62	3.14	6.99	4.87	11.34	4.54
T5	0	5.20	3.51	8.71	2.78	6.47	3.98	10.97	4.16
	Mean	5.31	3.86	9.17	2.96	6.73	4.38	11.16	4.35
	+	5.87	4.86	10.73	3.76	7.26	4.46	11.72	4.97
T6	0	5.34	3.61	8.95	3.27	6.65	4.22	10.87	4.22
	Mean	5.61	4.24	9.84	3.51	6.96	4.34	11.30	4.60
	+	4.82	3.41	8.23	3.09	6.20	4.36	10.56	3.83
T7	0	4.71	3.30	8.01	2.96	5.66	4.17	9.83	2.98
	Mean	4.77	3.36	8.12	3.03	5.93	4.27	10.20	3.41
	+	4.90	3.64	8.54	3.44	6.43	4.02	10.45	3.35
T8	0	4.67	3.30	7.97	3.16	6.05	3.88	9.54	3.14
	Mean	4.79	3.47	8.26	3.30	6.24	3.95	10.00	3.25
	+	4.55	3.48	8.03	3.18	6.39	3.77	10.16	3.92
T9	0	4.40	3.26	7.66	2.98	5.66	3.15	8.96	3.44
	Mean	4.48	3.37	7.85	3.08	6.03	3.46	9.56	3.68
Inoculation (+)		4.47	3.37	7.94	3.07	5.81	3.87	9.50	3.72
Non- inoculation (-)		4.09	2.88	7.30	2.72	5.32	3.52	8.84	3.12
LSD for									
Inoculation		0.46	0.43	0.37	0.22	0.48	0.12	0.54	0.32
Nutrient management		0.35	0.64	0.76	0.11	0.12	0.49	1.12	0.42
Interactions		0.19	0.35	0.84	0.27	0.79	0.54	0.29	0.46

TABLE 10. Influence of agronomic advancement in nutrients management on yield and yield components of wheat (*Triticum aestivum* L.) in winter season of 2014/2015.

Integrated nutrient	Seed inoculation	Spike length (cm)	No. of grains/ spike	1000 grain weight (g)	Grain yield (ton ha^{-1})	Biological yield (kg m^{-2})	HI %	Protein (%)
T1	+	9.5	43.9	52.14	5.65	1.500	37.67	10.20
	0	8.6	43.6	49.55	4.78	1.300	36.77	9.18
	Mean	9.05	43.75	50.85	5.22	1.400	37.22	9.69
T2	+	9.8	44.0	52.40	5.72	1.750	32.69	9.35
	0	8.9	43.2	47.98	4.66	1.200	38.83	9.00
	Mean	9.35	43.60	50.19	5.19	1.475	35.76	9.18
T3	+	9.7	44.2	47.95	5.95	1.670	35.63	10.00
	0	8.2	43.0	48.88	5.06	1.380	36.67	9.82
	Mean	8.95	43.60	48.42	5.51	1.525	36.15	9.91
T4	+	10.2	43.8	50.42	5.10	1.250	40.80	9.75
	0	8.5	43.4	48.44	4.80	1.200	40.00	9.41
	Mean	9.35	43.60	49.43	4.95	1.225	40.40	9.58
T5	+	10.3	44.4	52.55	6.00	1.850	32.43	10.82
	0	9.7	43.0	47.51	5.16	1.470	35.10	9.76
	Mean	10.00	43.70	50.03	5.58	1.660	33.77	10.29
T6	+	10.7	44.9	53.26	6.43	1.980	32.47	10.95
	0	9.9	43.6	52.20	6.22	1.770	35.14	10.00
	Mean	10.30	44.25	52.73	6.33	1.875	33.81	10.48
T7	+	10.3	45.0	53.67	6.50	1.880	34.57	10.45
	0	10.0	44.0	52.55	5.70	1.800	31.67	9.62
	Mean	10.15	44.50	53.11	6.10	1.840	33.12	10.04
T8	+	10.7	45.8	53.96	6.62	1.890	35.03	10.65
	0	10.4	44.8	52.75	5.89	1.860	31.67	9.32
	Mean	10.55	45.30	53.36	6.26	1.875	33.35	9.99
T9	+	10.8	45.4	53.74	6.31	1.990	31.71	10.77
	0	10.5	45.0	52.54	6.00	1.890	31.75	9.70
	Mean	10.65	45.20	53.14	6.16	1.940	31.73	10.24
General Means								
Inoculation (+)		10.22	517.0	52.23	6.03	1.751	34.78	10.33
Non- inoculation (-)		9.41	457.0	50.27	5.36	1.541	35.29	9.53
LSD for								
Inoculation		0.10	NS	1.24	0.38	0.035	--------	----------
Nutrient management		0.60	NS	1.56	0.52	0.20	---------	---------
Interactions		0.80	NS	1.22	0.21	0.11	--------	----------

TABLE 11. Influence of agronomic advancement in nutrients management on yield and yield components of wheat (*Triticum aestivum* L.) in winter season of 2015/2016.

Integrated nutrient	Seed inoculation	Spike length (cm)	No. of grains/ spike	1000 grain weight (g)	Grain yield (ton ha^{-1})	Biological yield (kg m^{-2})	HI %	Protein %
	+	9.90	44.50	48.16	6.55	1.66	39.46	10.81
T1	0	8.80	43.60	46.81	5.80	1.55	37.43	9.50
	Mean	9.35	44.05	47.49	6.18	1.61	38.45	10.16
	+	9.75	44.20	45.66	6.00	1.80	33.33	9.75
T2	0	8.60	43.60	44.37	4.86	1.56	31.15	9.25
	Mean	9.18	43.90	45.02	5.43	1.68	32.24	9.50
	+	10.00	44.00	46.72	5.58	1.87	29.84	10.25
T3	0	9.90	44.00	45.46	5.19	1.55	33.48	9.31
	Mean	9.95	44.00	46.09	5.39	1.71	31.66	9.78
	+	10.30	44.90	47.82	5.90	1.89	31.22	10.75
T4	0	9.98	44.10	46.93	5.70	1.68	33.93	9.44
	Mean	10.14	44.50	47.38	5.80	1.79	32.58	10.10
	+	10.60	46.20	49.72	6.50	1.98	32.83	11.75
T5	0	10.40	44.00	48.97	5.85	1.82	32.14	9.63
	Mean	10.50	45.10	49.35	6.18	1.90	32.49	10.69
	+	10.85	48.10	49.98	6.63	1.99	33.32	12.19
T6	0	10.50	45.10	49.63	5.98	1.88	31.81	9.81
	Mean	10.68	46.60	49.81	6.31	1.94	32.57	11.00
	+	10.28	45.25	48.88	6.22	1.84	33.81	10.75
T7	0	9.80	44.00	47.54	5.86	1.79	32.74	9.38
	Mean	10.03	44.63	48.21	6.04	1.82	33.28	10.07
	+	10.30	46.00	49.77	6.43	1.93	33.32	9.00
T8	0	9.95	44.80	48.95	5.30	1.74	30.46	9.44
	Mean	10.13	45.40	49.36	5.87	1.84	31.89	9.22
	+	10.48	45.40	50.24	6.30	1.98	33.33	11.38
T9	0	9.98	44.89	48.95	5.94	1.87	31.76	9.56
	Mean	10.23	45.15	49.60	6.12	1.93	32.55	10.47
General means								
Inoculation (+)		10.27	45.39	48.55	6.23	1.88	33.33	10.74
Non- inoculation (-)		9.77	44.23	47.51	5.61	1.71	32.89	9.48
LSD for								
Inoculation		0.47	0.97	0.93	0.48	0.14	------	……
Nutrient management		0.19	1.10	0.33	0.12	0.11	------	…..
Interactions		0.27	0.94	0.34	0.21	0.10	------	…..

Additionally, seed inoculation induced further increased in yield and yield component parameters as compared to treatments of non-inoculated seed, such effect might be due to, the reason of increasing nutrient availability and role of microorganism in creating favorable conditions to plant absorption, nutrients up take, translocation and ultimately increase biomass yield and accumulation in yield performance. Several investigators suggested that, the Positive response of plants grown with inoculated seeds could be due to the provision of nutrients especially nitrogen, phosphorus and growth promoting hormones, which are transformed as the action of microorganisms to available form thereby motivating their activities (Worthington, 2001; Assaf et al., 2009; Babajide et al., 2012).

Grain quality

Quality traits was determined as grain protein content (%), Since protein content of grain is essentially a manifestation of N content, then increased N content due to integrated nutrient management and seed inoculation with *Rhizobium* or PSB resulted in higher protein content (Tables 10 and 11).

Summary and Recommendation

As there are clear negative outcomes due to the continuous overuse of chemical fertilizers, for example create serious problems related to nutrient deficiency, nutrient toxicity, and low nutrient use efficiency. The present study demonstrated that, recycling agriculture wastes to good quality compost has a priority for reducing the payment of high costs of chemical fertilizers and gain a sunny role and additional benefit in rationalization the use of inorganic fertilizers, particularly at small-scale farmer level, who haven't enough money to pay the claim of fertilizers. In general, results concluded that, the applications of organic manure performed favorably the same or better than NPK fertilizer. Furthermore, among the three types of manures, poultry litter manure compost seemed to be the best one, followed by the mixture of sheep and camel manure compost and cow manure compost came in the last series. In addition, further application of large quantities of organic manure may be become without a concrete returns, because every soil has its own carrying capacity. Although a large amount of compost has been added, there has been no positive impact for this increase. Thus, adopting combatable and homogenous combination of inorganic, organic and biofertilizers can be wisely improved both soil and crop production. Noticeable positive and significant effect was recorded, due to integrated nutrient management exhibited higher values of most of the growth parameters, photosynthetic productivity as well as yield and yield component characters than the recommended dose of inorganic fertilizers. Plants received the mixture of the three types of compost by the rate of 10ton ha^{-1} + half dose of recommended NPK (T6) followed by that received the mixture of the three types of compost by the rate of 5ton ha^{-1} + half dose of recommended NPK (T5), recorded the highest values of spike length, cm; number of grain per spike; 1000 grain weight, g; grain yield, ton ha^{-1}; biological yield, kg m^{-2}; harvest index in both seasons.

Acknowledgement: This Project was funded by the National Plan for Science, Technology and innovation (MAARIFAH), King Abdul-Aziz City for Science and Technology, Kingdom of Saudi Arabia, Award Number (12-AGR3110-02).

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تحسين إداره المغذيات للحفاظ على استدامة النمو و الإنتاجية في محصول القمح

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التحدي الرئيسي في السنوات القليلة القادمة في قطاع الزراعة يكمن فى الإجابة على سؤال واحد هل تستطيع الزراعة ان توفر لسكان العالم جميع الإحتياجات الغذائية التي تزداد سنويا وتتسع معها الفجوة الغذائية. وبناء علي ذلك، فأن تحقيق الأمن الغذائي يفرض ضغطا غير مسبوق على الباحثين الزراعيين وجميع المشتغلين فى قطاع الزراعة. أجريت تجارب حقلية في تصميم القطاعات الكاملة العشوائية (RCBD) فى أربعه تكرارات، بمحطة الأبحاث والتجارب الزراعية التابعة لكلية علوم الأغذية والزراعة - جامعة الملك سعود بمنطقة ديراب جنوب الرياض، بغرض تقييم تأثير المعاملات السمادية المتكاملة للسماد الكيماوى والعضوى والحيوي على القمح الربيعي. وشملت المعاملات ثمانيه عشر معاملة عبارة عن توافيق من سماد المخلفات الزراعية المتحلل بفعل ثلاثة انواع من المحفزات (روث الدواجن، روث الابقار، خليط من روث الجمل والغنم) مع الجرعة الموصى بها أو نصف الجرعة الموصى بها الأسمدة الكيماوية (ن فو بو) فى وجود التلقيح البكتيرى للبذور أو بدون تلقيح البذور بخليط من البكتيريا المثبتة النيتروجين (*Azotobacter*) أو المذيبة للفوسفور (*Pseudomonas* sp.) PDB. استنادا إلى النتائج التي تم الحصول عليها، تفوق السماد المتحلل الناتج من استخدام منشط روث الدواجن على النوعين الاخرين فى جميع الصفات تحت الدراسة، يلي السماد الناتج من استخدام خليط من روث الجمال والأغنام ثم اخيراً السماد الناتج من روث الأبقار، كما أظهرت النتائج أن إضافة مخلوط من الثلاثة انواع من السماد بمعدل (5 ــ 10 طن هكتار$^{-1}$) مع نصف المعدل الموصى به من الأسمدة الكيماوية استطاع أن يعوض النقص فى كمية السماد الكيماوى المضافة وتفوق على باقى المعاملات. كما أظهرت النتائج أن معاملة البذور بخليط من الملقح البكتير كان له تأثير ايجابى على كل من النمو والمحصول ومكوناتة. انتهت الدراسة إلى أن إعادة تدوير المخلفات الزراعية وتحويلها الى سماد واستخدامة فى تخفيض الجرعات المضافة من الأسمدة الكيماوية بديل مقبول عند المزارعين .