CORRELATION AND REGRESSION ANALYSIS OF GROWTH, YIELD AND YIELD COMPONENTS OF WHEAT (TRITICUM AESTIVUM) UNDER DIFFERENT DOSES OF NUTRIENTS WITH BIOFERTILIZERS

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Abstract

A study was carried out at Student's Farm, School of Organic Farming, Punjab Agricultural University, Ludhiana and PAU Regional Research Station Bathinda, during rabi 2018-19. The experimental sites were normal soil pH and electrical conductivity, low in organic carbon and available N and medium in available P and K on both locations. The investigation consisted of 13 treatments each having different levels of nitrogen and phosphorus and two methods of biofertilizers application that were seed treatment and soil application. Results revealed that highest growth and yield attributing characters were found in treatments where 12.5 and 25 % less dose of chemical fertilizers with combination of biofertilizers were applied.Means biofertilizers have capacity to supply nutrients to plants even with less doses of chemical fertilizers. The results showed a higher number of tillers, effective tillers, number of grains/ear, 1 000-grain weight and grain yield of wheat with decreasing nutrient levels up to 75 % of recommended dose of fertilizers. However highest grain yield of wheat (5435 and 5417 kg ha-1) was recorded under 87.5 % RDF applied treatments with biofertilisers, and lowest grain yield was recorded in treatments T1 (control plot). Determination of correlation matrix revealed that crop yield was perfectly postively correlated with crop growth parameters like dry matter accumulation, LAI, tiller number m-2, effective tillers m-2, ear length, and number of grains ear-1 etc. Regression and correlation analysis interpreted positive relation of grain yield with growth parameters and yield parameters. From the study it can be concluded that approximately 12 %, chemical fertilizers can be altered with biofertilizers and with this higher yield can be obtained then recommended dose of fertilizers.
Key Words: Bio Fertilizer, Wheat, Grain Yield, Correlation and Regression

Introduction

King of cereal wheat is an important food crop in the world. It is an annual plant of gramineae family. It contains 14% protein which is much higher than other cereals. The rank of India in production of wheat is fourth after Russia, USA and China. The world population is likely to increase to 9.6 billion from present status of 7.2 billion by 2050 (Singh et al 2016). However in order to feed such a continuous growing population, the global food grain production needs to be increased by 70% on sustainable basis. To meet and sustain the growing demand of food there is need to increase the production per unit area as well as time. Growth of the plant was affected by nitrogen and phosphorous application to the crop but use of these nutrients in form of chemical fertilizers is not economical and eco friendly. Therefore, in order to achieve higher growth of plants with less use of chemical fertilizers is the main question here. Among the choices available with us the organic fertilizers, bio fertilizers and plant growth promoting rhizobacteria (PGPRs) are the important ones (Sharma et al 2011). The only alternate to increase and sustain the productivity is to develop a system in which the nutrients are added through combined use of organic sources i.e. manures, biofertilizers and composts. Biofertilizers are living cell containing microbes which improve the uptake and solubility of plant nutrients by increasing root surface area through colonization of plant rhizosphere and facilitates nutrient. These are considered as precious constituent of sustainable agriculture in integrated plant nutrient management as well as holding enormous pledge in increasing the yield of crop plants (Narula et al 2005). Biofertilizers play a significant role in improving soil fertility by fixing atmospheric nitrogen, both, in association with plant roots and without it, solublise insoluble soil phosphates and produces plant growth substances in the soil. They are in fact being promoted to harvest the naturally available, biological system of nutrient mobilization. It has been perceived that the soil contain free living microscopic organisms which are able to fix nitrogen non-symbiotically. The non symbiotic nitrogen fixer Azotobacter sp. has found to be beneficial for a wide range of crops due to its ability to fix atmospheric nitrogen, production of Indole Acetic Acid and fixation of atmospheric nitrogen, antibiotic production, siderophore production (Anjum et al 2007). Likewise, soil bacteria which belonging to the Streptomyces group have potential to produce various substances like enzymes, enzyme inhibitors, plant growth promoters, alkaloids and vitamins. These bacteria support symbiosis, better growth and resistance to various biotic and abiotic stresses.

Material and methods

The experiment was conducted at Student's Farm, School of Organic Farming, Punjab Agricultural University, Ludhiana and PAU Regional Research Station Bathinda, during rabi 2018-19. Ludhiana is located in Trans-Gangatic agro-climatic zone and represents the Indo-Gangatic alluvial plains. It is located in 30° 56' N latitude and 75° 52' E longitude at an altitude of 247 m above the MSL. Ludhiana is characterized by sub-tropical semi-arid type of climate with hot summer and cold winters. However, Bathinda is located at 30° 12'N and 74° 56'E at 210 meters above mean sea level and placed in the southwestern region of Punjab. The climate of the place is mainly characterized by a very hot summer, a short rainy season and a bracing cold winter. At both locations the soil was normal in pH i.e. 8.4 and 7.8, low in organic carbon i.e. 0.25 and 0.22, low available N i.e. 140.35 and 135.26 kg ha-1 and medium in available P and K. The experiment was laid out in Randomized Complete Block Design (RCBD) with 13 treatments, viz. T1:Control, T2:RDF, T3:RDF +Azotobacter sp. +Streptomyces badius (Seed Treatment),T4: 87.5% N +100% P +Azotobacter sp. + Streptomyces badius (Seed Treatment), T5:75% N + 100% P +Azotobacter sp. + Streptomyces badius (Seed Treatment), T6:100% N + 87.5% P +Azotobacter sp. + Streptomyces badius (Seed Treatment), T7:100% N + 75% P +Azotobacter sp. + Streptomyces badius (Seed Treatment),T8: 87.5% N + 87.5% P +Azotobacter sp. + Streptomyces badius (Seed Treatment),T9:75% N + 75% P +Azotobacter sp. + Streptomyces badius (Seed Treatment), T10: RDF +Azotobacter sp. + Streptomyces badius (Soil Application) T11:87.5%N + 100%P +Azotobacter sp. + Streptomyces badius (Soil Application), T12: 100%N +87.5% P + Azotobacter sp. + Streptomyces badius (Soil Application), T13 87.5%N + 87.5% P+ Azotobacter sp. + Streptomyces badius (Soil Application) and replicated three times. Sowing of wheat variety unnat PBW 343 was done on November 20 and 22, 2018 at Ludhiana and Bathinda, respectively, with Kera method using seed rate of 100 kg/ha. All crop management practices were performed as per recommendation of Punjab Agricultural University Ludhiana. Half the dose of nitrogen and full dose of phosphorus and potassium was applied at the time of sowing by broadcasting method. Remaining half nitrogen was applied by top dressing after first irrigation. Growth parameters of crop like plant height, dry matter accumulation, leaf area index (LAI), number of tillers and yield contributing characters like effective tillers, ear length, number of grains ear-1 were recorded periodically during the crop growth cycle. To study the effect of biofertilizers on growth and productivity of wheat crop data was analyzed under CPCS1 software. Correlation matrix, scatter plot diagrams and regression equations were determined for both the Locations in SPSS stat software.

Result and Discussion

Growth parameters

Plant height

On both locations Bathinda and Ludhiana plant height was found to be non statistically effected by use of biofertilizers. However maximum plant height was recorded in T8 where 87.5%N + 87.5% P +Azotobacter sp. + Streptomyces badius were applied followed by T9 where 75%N + 75% P +Azotobacter sp. + Streptomyces badius were applied (Table 1). Plant height was non significant but 6.2 % higher plant height was obtained in 87.5% N + 87.5% P +Azotobacter sp. + Streptomyces badius (ST) as compared to RDF. Increase in plant height was due to N fixation by biofertilizers and production of enzymes, protein synthesis by the Azotobacter sp. + Streptomyces badius. The combined use of Arbuscular mycorrhizal fungi and plant growth promoting rhizobacteria (PGPR) with Bacillus polymyxa, Azospirillum mixed with phosphorous increased the growth of crop plants (Noreen and Noreen 2012). Khan et al (2016) also found similar result that seed inoculation of biofertilizer increase the plant height. This may be due to effect of Azotobacter spp. and Streptomyces badius. They replace the inorganic fertilizers up to 25% then the recommended dose of fertilizers. Seed treatment of biofertilizers found to be beneficial then the soil application as higher plant height was obtained in treatments where biofertilizers were applied as seed treatments.

Number of tillers m-2

Application of biofertilizers with seed treatment or soil application with less doses of nitrogen and phosphatic fertilizer influences the number of tillers m-2.At all the growth stages, different combination of biofertilizers and chemical fertilizers significantly affected the tiller count. At 120 DAS higher plant tillers (483 and 459) were observed (Table 1) in 87.5% N + 87.5% P +Azotobacter sp. + Streptomyces badius (ST) which was statistically at par with 75% N + 75% P +Azotobacter sp. + Streptomyces badius (ST) and 100% N + 75% P +Azotobacter sp. + Streptomyces badius (ST) . Biological nitrogen fixation entirely depends upon available nitrogen and phosphorus in the soil. The lower availability of N and P in 87.5% N + 87.5% P +Azotobacter sp. + Streptomyces badius (ST), 75% N + 75% P +Azotobacter sp. + Streptomyces badius (ST) and100% N + 75% P +Azotobacter sp. + Streptomyces badius (ST)may increases the activity of nitrogenase enzymes as BNF entirely depends upon symbiotic and associative relation of diazotrophs and host plants however when there is excess supply of N and P the activity of biofertilizers suppressed in many bacterial species (Gangwar et al 2018). So this resulted in higher uptake of N and P in treatments having less doses of N and P. Singh et al (2016) also obtained similarly results wthat higher number of tillers m-2 in treatments where seed was treated with Azotobacter, Phosphate Solubilizing bacteria (PSB) and co-inoculation of Azotobacter +PSB).

Chlorophyll content

Photosynthesis is an important process in plants which is responsible for production of food for the plants. Chlorophyll (CC) content was an important photosynthetic pigment to plants which largely determine the photosynthetic capacity of the plants (Ying et al 2018). Productivity of any plants will depend on the photosynthesis, which directly depends on chlorophyll content in leaves.

At 90 DAS, highest chlorophyll content 2.39 and 2.39 mg plant-1 was noted in 87.5% N + 87.5% P +Azotobacter sp. + Streptomyces badius (ST) on both locations i.e. Bathinda and Ludhiana. This might be due to activity of biofertilizers which enhance the uptake of N and P for the plants which resulted in more production of chlorophyll. At 90 DAS lowest chlorophyll content 2.17 and 2.18 mg plant-1 was recorded in control plot where there is no application of chemical fertilizer and biofertilizers

When we apply biofertilizers with 12.5% and 25% less chemical fertilizers, the activity of biofertilizers was increased because biofertilizers are living entity which was harmed by the chemical fertilizers so this resulted in higher chlorophyll content in treatments having less application of chemical fertilizer. The lowest chlorophyll content in the control plotwas due to less availability of nitrogen in soil as N is the main component of the chlorophyll in plants. Chanderashekhar et al (2005)also reported the beneficial effect of biofertilizers on increased chlorophyll content due to availability of nitrogen near the root zone of plants and as a result higher supply of nitrogen to the growing tissue of plants.

Leaf area index

Leaf is a principal organ in which primary production of photosynthates takes place, so green area in relation to ground is of great importance. Leaf area index (LAI) tells about the plant cover to ground area ratio. More healthy and taller plants have higher LAI. Data related to LAI shown in Table 3, different combinations of chemical fertilizers and biofertilizers non significantly affect the LAI 120 DAS at both locations. At 120 DAS highest LAI (4.43 and 4.30) was obtained in 87.5% N + 87.5% P +Azotobacter sp. + Streptomyces badius (ST) followed by (4.38 and 4.24) 75% N + 75% P +Azotobacter sp. + Streptomyces badius (ST) and 100% N + 75% P +Azotobacter sp. + Streptomyces badius (ST). Highest LAI might be due to enhanced accumulation of photosynthates which affect higher dry matter accumulation because of higher availability of nutrients. Similar, Tejaswini et al (2017) obtained higher LAI, where application of biofertilizers was done.

Dry matter accumulation

Dry matter accumulation is also excellent growth parameter to identify metabolic activity of the plants. Biofertilizers non significantly affect the dry matter accumulation (DMA) of plant. However highest dry matter accumulation (98.66 and 93.15 q ha-1) was observed in 87.5% N + 87 .5 % P +Azotobacter sp. + Streptomyces badius (ST) at Bathinda and Ludhiana respectively. Biofertilizers fix atmospheric N near the root zone of the plant. In treatments where less doses of fertilizers were applied, activity of biofertilizers increased because chemical fertilizers have negative effect on biofertilizers. Similarly, Kader et al (2015) concluded that biofertilizers have significant effect on the DMA in wheat. It was highest with application of 168 kg N ha-1 with biofertilizers application.

Yield parameters

Number of grains spike-1

The number of grains spike-1 is a vital yield contributing character and it has a direct effect on the grain yield of wheat. Grains are fertilized ovule of spikelet which contributes to the grain yield. Different doses of fertilizers with biofertilizers significantly affect the number of grains spike-1. Maximum number of grains 50.67 and 50.54 was obtained (Table 2) with 87.5% N + 87.5% P +Azotobacter sp. + Streptomyces badius (ST) which was statistically at par with 100% N + 75% P +Azotobacter sp. + Streptomyces badius (ST) and 75% N + 75% P +Azotobacter sp. + Streptomyces badius (ST) on both locations of Bathinda and Ludhiana. Number of grains spike-1 was lowest in control with no application of fertilizers and biofertilizers.

Spike length

Spike length act as a reliable criterion for accessing number of grains spike-1, which directly affect the grain yield of wheat. At Bathinda, biofertilizers significantly affect the spike length and the highest spike length (9.33cm) was noted in 87.5%N + 87.5% P +Azotobacter sp. + Streptomyces badius (ST) which was statistically at par with T7 and T9 (Table 4.8). This might be due to higher uptake of nutrients in treatments where biofertilizers with less dose of chemical fertilizers was applied. Mardalipour et al (2014) obtained the higher spike length where biofertilizers was applied. At Ludhiana, the effect of biofertilizers on spike length was non significant. But higher spike length (9.07 cm) was noted in 87.5% N + 87.5% P +Azotobacter sp. + Streptomyces badius (ST) followed by 75% N + 75% P +Azotobacter sp. + Streptomyces badius (ST) and 100% N + 75% P +Azotobacter sp. + Streptomyces badius (ST).

Effective tillers m-2

Effective tillers m-2 is an important parameter which directly affects the grain yield of wheat. Data related to effective tillers m-2 was significantly affected by biofertilizers. Biofertilizers significantly affect the effective tillers m-2 at harvesting stage of the crop. At Bathinda, higher effective tillers m-2 (432) was found in 75% N + 75% P +Azotobacter sp. + Streptomyces badius (ST) followed by 430 in 87.5% N + 87.5% P +Azotobacter sp. + Streptomyces badius (ST) and 428.67 in 100% N + 75% P +Azotobacter sp. + Streptomyces badius (ST). At Ludhiana, higher effective tillers m-2 were found in 87.5% N + 87.5% P +Azotobacter sp. + Streptomyces badius (ST) followed by 75% N + 75% P +Azotobacter sp. + Streptomyces badius (ST) and 100% N + 75% P +Azotobacter sp. + Streptomyces badius (ST).

Thousand grain weight

The thousand grain weight directly depends upon grain filling period and LAI. Data revealed that, thousand grain weight was non significant on both locations but numerically higher (42.87 and 42.52 g) was recorded in 87.5% N + 87.5% P +Azotobacter sp. + Streptomyces badius (ST) followed by (42.83 and 42.30 g) in 100 % N + 75 % P + Bio (ST).

Grain yield

Grain yield is final output of any crop which directly depends upon factors such as number of grains spike-1, effective tillers m-2, test weight and growth parameters. Azotobacter sp. and Streptomyces badius significantly affect the grain yield of wheat. Treatments having higher values of dry matter accumulation, LAI, plant height, chlorophyll content and yield attributing characters resulted in higher grain yield. At Bathinda the highest grain yield 5435 kg ha-1 was observed in 87.5% N + 87.5% P

+Azotobacter sp. + Streptomyces badius (ST) which was statistically at par with all other treatments except control. In 87.5% N + 87.5% P +Azotobacter sp. + Streptomyces badius (ST) 12.85% higher grain yield was observed as compared to RDF and 11.75 and 11.28% higher grain yield was obtained in 75% N + 75% P +Azotobacter sp. + Streptomyces badius (ST) and 100% N + 75% P +Azotobacter sp. + Streptomyces badius (ST), respectively

At Ludhiana, 11.14, 11.10 and 10.88% higher grain yield were obtained in 87.5% N + 87.5% P +Azotobacter sp. + Streptomyces badius (ST), 75%N + 75% P +Azotobacter sp. + Streptomyces badius (ST) and 100% N + 75% P +Azotobacter sp. + Streptomyces badius (ST) respectively as compared to RDF.

Straw yield

Straw was obtained after threshing of the wheat crop. It was affected by growth attributing characters as plant height, dry matter accumulation and leaf area. At both locations straw yield was significantly affected by different combinations of biofertilizers with chemical fertilizers. Higher straw yield 6425 and 6036 kg ha-1 was observed in 87.5% N + 87.5% P with Azotobacter sp. and Streptomyces badius (ST) followed by 6315 and 5949 kg ha-1 in 75% N + 75% P +Azotobacter sp. + Streptomyces badius (ST) at Bathinda and Ludhiana, respectively.

Table1. Effect of different doses of nitrogen and phosphorous on growth and growth parameters of wheat

Treatment	Plant height (cm) At harvest	Number of tillers m-2 120 DAS	CC (mg plant-1) 90DAS	LAI 120 DAS	DMA (q ha-1) 120 DAS					
	Treatment	Plant height (cm) At harvest	Number of tillers m-2 120 DAS	CC (mg plant-1) 90DAS	LAI 120 DAS	DMA (q ha-1) 120 DAS	Treat ment	Plant height (cm) At harvest	Number of tillers m-2 120 DAS	CC (mg plant-1) 90DAS
T1: Control	95.2	93.4	302	280	2.17	2.18	3.30	3.40	68.69	69.98
T2: RDF	102.8	101.5	387	403	2.36	2.36	3.63	3.67	72.01	72.8
T3: RDF+Bio (ST)	105.9	104.8	426	423	2.36	2.36	3.93	4.06	90.83	81.23
T4: 87.5%N+100 %P+Bio (ST)	105.9	105.6	432	437	2.30	2.27	3.91	4.09	93.56	81.84
T5: 75%N+100%P	106.2	105.2	430	431	2.29	2.30	3.94	4.14	92.83	84.80

T6: 100%N+87.5 %P+Bio (ST)	107.3	105.8	436	442	2.34	2.38	4.18	4.22	94.03	88.28
T7: 100%N+75%P +Bio (ST)	107.7	107.1	442	444	2.35	2.35	4.31	4.21	95.63	92.53
T8: 87.5%N+87.5 %P+Bio (ST)	109.2	108.0	483	459	2.39	2.39	4.43	4.30	98.66	93.15
T9: 75%N+75%P+ Bio (ST)	108.7	107.6	463	454	2.36	2.33	4.38	4.24	96.70	91.81
T10: RDF+Bio (SA)	103.0	102.2	393	381	2.35	2.35	3.90	3.73	75.23	74.56
T11: 87.5%N+100 %P +Bio (SA)	103.1	103.4	395	393	2.35	2.30	3.93	3.96	79.81	75.5
T12: 100%N+87.5 %P +Bio (SA)	103.0	104.0	405	403	2.37	2.34	3.90	3.83	81.76	78.05
T13: 87.5%N+87.5 %P+Bio (SA)	104.5	104.4	407	422	2.32	2.33	3.85	3.90	84.48	80.4
CD (p=0.05)	NS	NS	71	75	NS	NS	NS	NS	NS	NS

Testing of hypothesis regarding correlation between crop yield and growth parameters, viz. dry matter accumulation at maturity, plant height, LAI at 90 DAS, tiller number m-2at 120 DAS, chlorophyll index at 90 DAS, effective tillers m-2, ear length, grains ear-1, was also performed by calculating correlation matrix through principal component analysis in SPSS stat software packages (Table 3 and 4). The results showed highly significant positive correlation of all parameters with wheat yield. The positive and significant correlation between growth and yield parameters with grain yield explains the true and direct relationship and these characters can be a major concern for grain yield. Scatter diagrams of LAI, tiller number, number of grains ear-1 and ear length showed positive relation with wheat yield (Fig 1 and 2). Regression equation of LAI described that per unit change in LAI causes increase in grain yield. In Regression analysis, grain yield is positively regressed to all growth and yield parameters.

Table 2. Effect of different doses of nitrogen and phosphorous on yield and yield parameters of wheat

Treatment	Number of grains spike-1	Spike length (cm)	Effective tillers m-2 at harvest	Test weight (g)	Grain yield (kg ha-1)	Straw yield (kg ha-1)						
	Bathinda	Ludhiana	Bathinda	Ludhiana	Bathinda	Ludhiana	Bathinda	Ludhiana	Bathinda	Ludhiana	Bathinda	Ludhiana
T1: Control	38.00	34.34	6.97	6.93	248	226	35.79	35.49	3460	3490	4474	4078
T2: RDF	45.00	43.00	7.40	7.77	353	322	40.74	39.87	4816	4877	5259	4992
T3: RDF+Bio (ST)	48.00	45.67	8.00	8.2	377	351	41.49	40.68	5034	4995	5877	5391
T4: 87.5%N+ 100%P+ Bio (ST)	49.67	46.00	8.50	8.43	401	387	41.15	41.03	5146	5274	6038	5500
T5: 75%N+100%P+Bio (ST)	48.67	46.00	8.20	8.23	384	356	41.26	40.11	5095	5042	5916	5402
T6: 100%N+87.5%P+Bio (ST)	50.00	47.00	8.69	8.6	419	388	42.05	41.42	5306	5384	6057	5588
T7: 100%N+75%P+Bio (ST)	50.00	48.00	8.93	8.73	428	405	42.83	42.3	5359	5419	6264	5735
T8: 87.5%N+ 87.5%P+ Bio (ST)	50.67	50.54	9.33	9.07	430	425	42.87	42.52	5435	5417	6425	6036
T9: 75%N+75%P+Bio (ST)	50.54	49.34	9.17	8.93	432	424	42.64	42.3	5381	5406	6315	5949
T10: RDF+Bio (SA)	45.00	43.44	7.60	7.83	351	327	40.41	39.96	4891	4845	5650	5128

T11: 87.5%N+ 100%P +Bio (SA)	46.67	44.00	7.63	7.9	365	333	40.02	40.08	4892	4899	5726	5251
T12: 100%N+87.5%P +Bio (SA)	47.00	44.33	7.73	8	360	344	40.5	40.28	4942	4912	5719	5234
T13: 87.5%N+ 87.5%P+ Bio (SA)	47.00	45.00	7.87	8.03	373	346	40.26	40.91	4978	4985	5822	5354
CD (p=0.05)	6.53	7.35	1.29	NS	97	80	NS	NS	990	947	907	NS

Table 3. Correlation matrix between wheat crop yield and crop growth parameters

Correlations			
Growth parameters	Grain yield		
	Bathinda	Ludhiana	Total
Plant height	.967**	.977**	.965**
Number of tillers(120 DAS)	.953**	.980**	.966**
Chlorophyll content(90 DAS)	.821**	.765**	.791**
Leaf area index(120 DAS)	.887**	.887**	.884**
Dry matter accumulation(120 DAS)	.804**	.784**	.758**
**. Correlation is significant at the 0.01 level (2-tailed).			
*. Correlation is significant at the 0.05 level (2-tailed).			

Table 4. Correlation matrix between wheat crop yield and yield attributes

Correlations			
Yield parameters	Grain yield		
	Bathinda	Ludhiana	Total
Number of grains per spike	.972**	.968**	.916**
Spike Length	.806**	.920**	.850**
Effective tillers	.972**	.955**	.935**
Thousand Grain weight	.976**	.979**	.969**
Straw yield	.960**	.956**	.858**
Biological yield	.990**	.989**	.961**
**. Correlation is significant at the 0.01 level (2-tailed).			
*. Correlation is significant at the 0.05 level (2-tailed).			

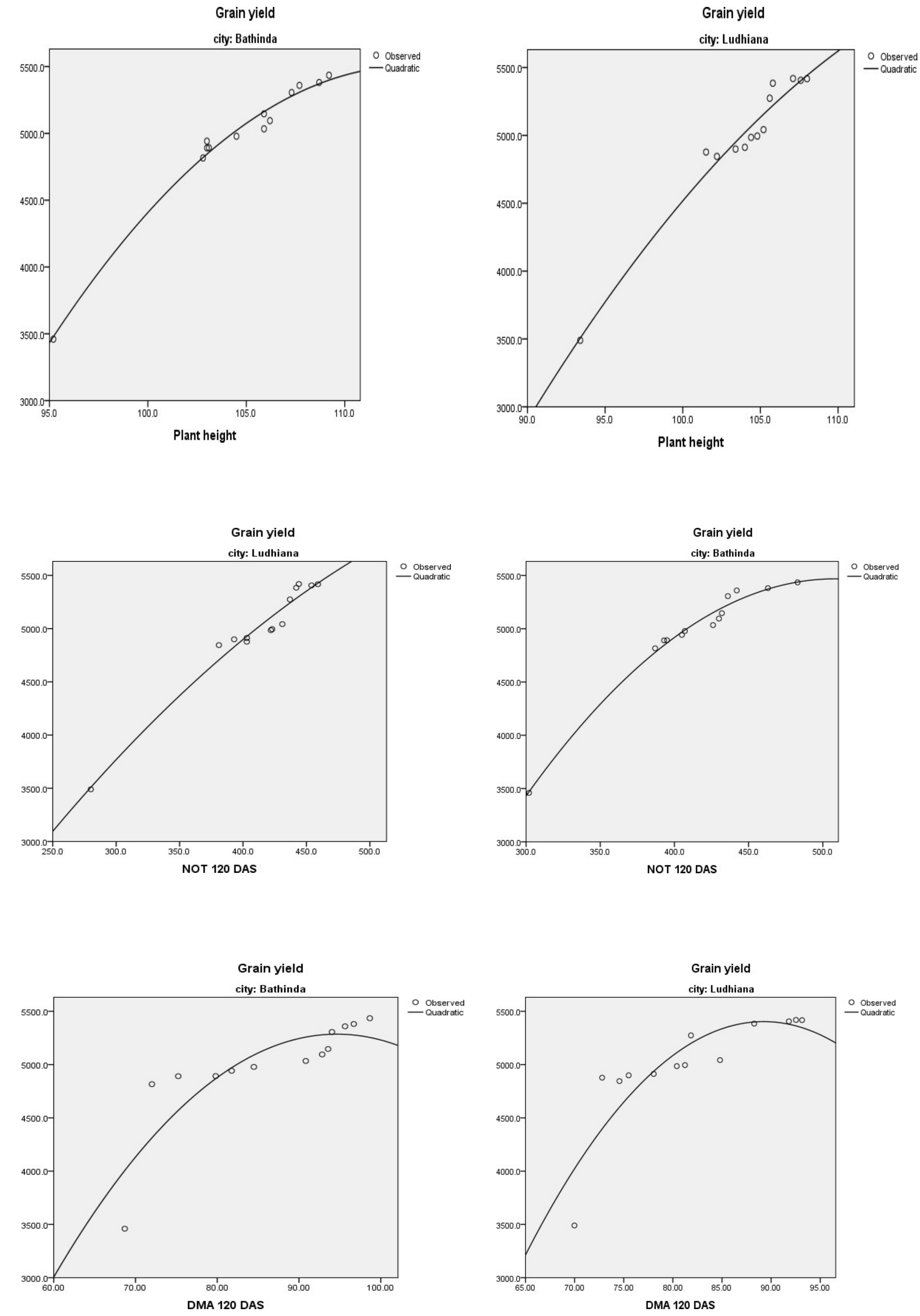

Fig 1. Regression analysis between growth parameters and yield of wheat

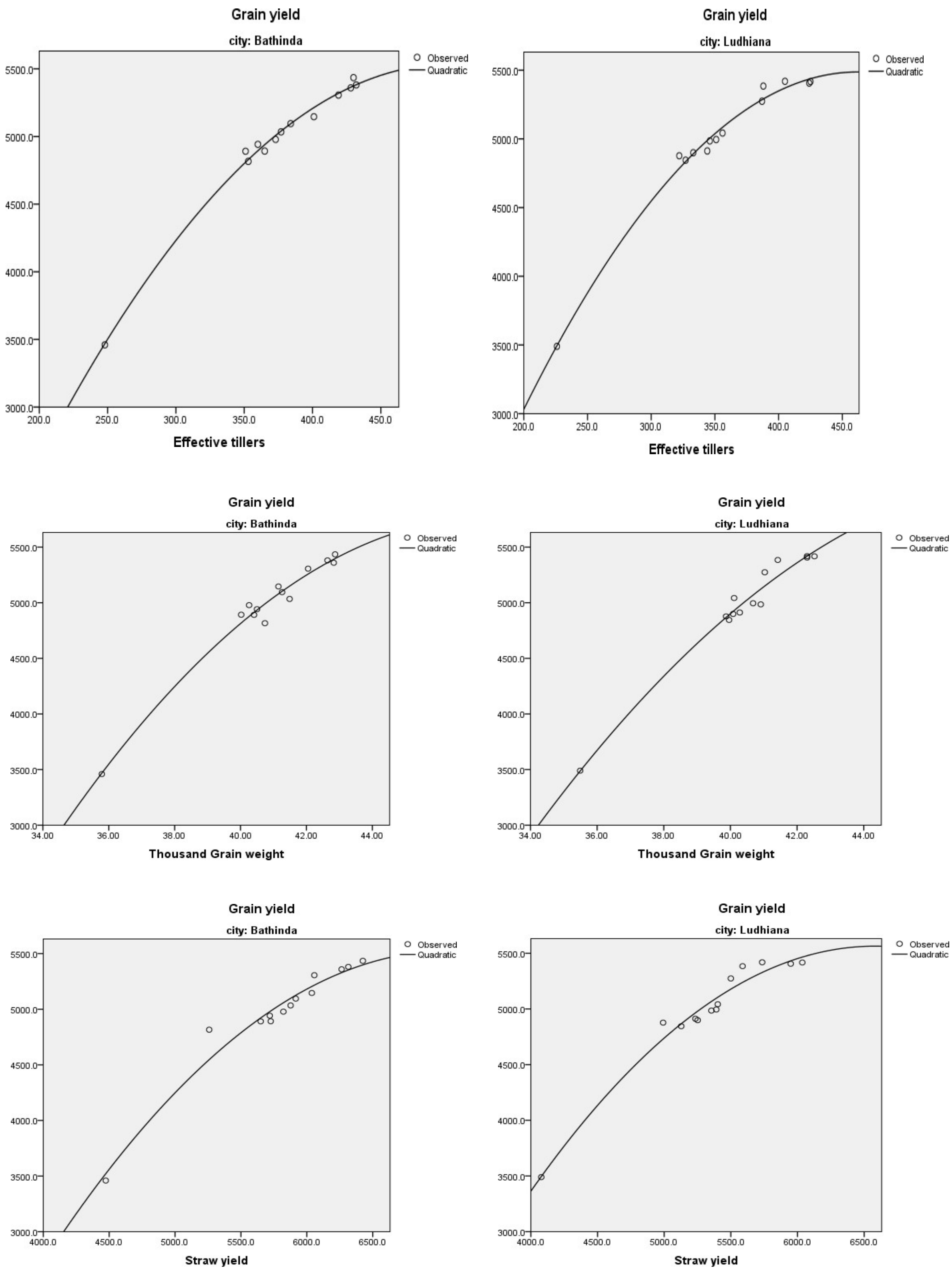

Fig 2. Regression analysis between yield parameters and yield of wheat

References:

·Anjum M A, Sajjad M R, Akhtar N, Qureshi M A, Iqbal A, Jami A R and Mahmud-ul-Hasan. 2007. Response of cotton to plant growth promoting Rhizobacteria (PGPR) inoculation under different levels of nitrogen. Journal of Agriculture Research 45:135-43.

·Chanderashekhar B R, Ambrose G and Jayabalan N .2005. Influence of biofertilizers level and nitrogen source level on the growth and yield of Echinochloa Frumentacea (Robx.) link. J Agri Tech1:223-34.

·Gangwar M, Pandove G, Brar S K, Kaur S and Kumar R . 2018 . Integrated Nutrient Management in Wheat by use of Azotobacter spp. and Streptomyces badius. International Journal of AgricultureInnovations and Research6:13-16.

·Kader M A, Mian M H and Hoque M S .2002. Effects of Azotobacter inoculant on to yield and nitrogen uptake by Wheat. J Biol Sci2:259-61

·Khan Z A, Muhammad H, Khalil S K and Amin R.2016. Efficiency of Wheat as Affected by Organic and Inorganic Nitrogen Fertilizer alone and in Combination with Effective Microorganism. Mid East Journal of Agriculture Research5:435-41.

·Mardalipour M, Zahedi H and Sharghi Y.2014 Evaluation of Nano biofertilizer efficiency on Agronomic traits of spring wheat at different sowing dates. Biological formInternational Journal6:349-56.

·Narula N, Kumar V, Singh B, Bhatia R and Kumar L.2005. Impact of Biofertilizers on grain yield in spring wheat under varying fertility conditions and wheat-cotton rotation. Archives of Agronomy and Soil Science51:79-89.

Noreen F and Noreen S .2014. Effect of different fertilizers on yield of wheat. International Journal of Science and Research3:1596-99.

·Sharma V K and Singh R P.2011. Organic matrix based slow fertilizer enhances plant growth, nitrate assimilation and seed yield of Indian mustard (Brassica juncia L.). Journal of Environmental Biology 32:619-24.

·Singh J S, Kumar A, Rai A N and Singh D P.2016. Cyanobacteria: A Precious Bio-resource in Agriculture, Ecosystem, and Environmental Sustainability. Frontier Microbiology7:529.

·Tejaswini M, Sreedevi B, Aukla B, Kumar A and Singh A .2017. Effect of Cultivars and Biofertilizers on growth, yield and nutrient content of aerobic rice (Oryza sativa L). Environment and Ecology4:3022-27.

·Ying, He N, Hou J, Liu C, Zhang J, Wang Q and Wu Xiuqin .2018. Factors influencing leaf chlorophyll content in natural forests at the biome schale. Environment and Ecology6: 64.