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WEEDS DENSITY AND LATE SOWN MAIZE PRODUCTIVITY INFLUENCED BY COMPOST APPLICATION AND SEED RATES UNDER TEMPERATE ENVIRONMENT

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ABSTRACT

Weeds reduces huge amount of yield of the economic crop ranging from 30 to 70 % of the total production. In upland environment weeds are usually found abundant in field as compared in low land environment due to the dissemination of weeds by animals, winds and due to spring water. Spring water brings weeds seeds to field by passing of water through grassy and Soddy channels in brushy congested herbaceous hilly area and some time by grazing of animals. Weeds spread in to farmer fields in this way. Therefore current field experiment was conducted to evaluate the influence of seed rate and compost on weeds density and late sown of maize productivity. At high elevations in Swat-Pakistan optimum time for maize sowing started from May 15th and continued till to June 15th whereas the experimental plots were sown on July 15th 2013. Experiment was comprised on four compost levels (5, 10, 15 and 20 Mg ha^{-1}) and four seed rate (10, 20, 30 and 40 kg ha^{-1}) with a test cultivar (cv. Baber). Subplot size was kept 3 m in length and 4.5 m in width (13.5 m^{2}). Weeds density significantly influenced all the agronomic traits of the maize plant. Seed rate and compost application significantly affected weeds population per unit area. Minimum weeds per unit area in all growth stages were observed with the application highest seed rate. It was observed from the results that seed rate @ 40 kg ha^{-1} and compost application at the rate of 5 Mg ha^{-1} reduced weeds population in all the investigated intervals (25, 50 and 75 DAS). Application of compost @ 20 Mg ha^{-1} produced optimum cob length (19 cm), plant height (179.19 cm), thousand grain weight (192.83 g) and grain yield (2712 kg ha^{-1}). While the optimum grain cob^{-1} were noted in seed sown at the rate of 30 kg ha^{-1} with the application of compost at the rate of 20 Mg ha^{-1} (375 grain cob^{-1}). On the basis of the above results it was concluded that to reduced weeds population per unit area and to enhanced productivity of maize crop seeds should be sown at the rate of 40 kg ha^{-1}with the application of Compost at the rate of 20 Mg ha^{-1} for late sowing under the agro ecological condition of Swat valley.

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INTRODUCTION

Maize is an important *kharip* crop of Pakistan belongs to family gramineae. It is grown in summer in Pakistan as well as in spring season. It is a multipurpose crop of Pakistan ranked 3rd after wheat and rice in cultivation (Imran, 2015). Maize is mostly known as tropical plants but now widely cultivated in sub-tropical and also in temperate regions of the country (Imran and Khan, 2015). Grain is a rich source of protein (10.4%), fats (4.5%), starch (71.8%) vitamins and minerals such as calcium, phosphorus and sulphur (Imran, 2015 and Aslam *et al*., 2011). It cover 60 % area in irrigated regions of the country while 36% lies under the rainfed condition (Tahir *et al*., 2009; Imran *et al.,* 2015). It provides many raw materials to starch industry for manufacturing of various products (Imran *et al.,* 2015). Corn seed possess non cholesterol oil and getting popularity due to this distinct feature (Martin *et al*., 1975, Imran *et al* 2015). It is widely cultivated throughout Khyber Pakhtunkhwa province of Pakistan (Shah *et al*., 2007). The crop is mostly raised in upland areas for animals forage and used as a livestock feed, and also for starch trade and oil production (FAO, 2007). In winter season upland regions face scarcity of animal feeds where it is used as a green chop and also fed to animal in the form of hay (Imran, 2015; Imran *et al.,* 2015).

Two-thirds of the total production of maize crop is used for livestock feeds. The crop is used One-third for domestic use as a cereal crop in temperate region. Upland people and farmers face food shortage in winter season due to mono-cropping system in the locality due to snow fall in the regions and mostly used corn flour for bread and human feeding purposes (Imran, 2015), Imran and Khan., (2015). Pakistan National average grain yield of maize is 3037 kg ha^{-1} which is very low as compared to other agriculturally advanced countries in which KP province shared 583 kg ha^{-1} (MINFA, 2009). Khyber Pakhtunkhwa produce little amount average grain yield as compared to Punjab and Sindh provinces. Upland, mountainous and hilly slopy regions possess little fertility, porosity, and retentivity of water and nutrients which is the main causes of the low yield. The degraded and declined soil of the upland regions could be improve by the use of organic fertilizers such as green manure, poultry manure, sheep manure, FYM, crop residues and compost application (Imran and Khan., 2015). Maize is an exhaustive crop required healthy soil for the provision of enough and frequently supply of mineral nutrients such as N, P and K and other trace elements for vigorous growth and optimum yield (Imran *et al.,* 2015). Compost and other organic materials application to soil increases soil heath, porosity, water holding capacity and supply of nutrients which leads frequent availability of major and minor mineral nutrients to crops (Khan *et al*., 2008).

There are several factors resulting significantly affect on maize production in upland environment however the soil of these regions are poor in retentivity of nutrients and water (Imran and Khan., 2015). Compost could improves the microbial activities to improve soil structure and nutrient availability (Imran and Khan., 2015). Luque *et al.*, 2006 and Aslam *et al*. (2011) reported that significant corn yields vary under different seed rate. Several others factors influence the growth of maize one of the most important factor is weed competition with maize crop for available resources (Imran and khan, 2015; Imran *et al.,* 2015). Under sufficient supply of major nutrients and soil moisture, successful maize production depends largely on effective weed control. The efficiency of water and fertilizers uses are the two most important input to get an optimum yield under irrigated condition and it is affected by poor weed control management (Tolessa and Friesen, 2001).

Keeping in view of the important role of weeds supersession and application of compost along with proper seed rate to maintain optimum plant per unit area to reduced weeds population and to proliferate the growth and yield of maize cop.

MATERIALS AND METHODS

To study weeds density and late sown maize productivity influenced by compost application and seed rate under temperate environment in Swat, Pakistan. The experimental design was used randomized complete block design (RCBD) having four replication. The seeds were collected from Cereal crop research institute (CCRI) Nowshera with the collaboration of Awami Welfare Society (AWS) Baidara Swat. Experimental project Agriculture Improvement Initiatives (AII) was launched by AWS funded by NRSP. The seeds were distributed among six hundred farmers in five union councils of tehsil Matta. Farmer Field Schools were established under the project in the locality. Technical training on maize productivity were delivered to all established FFS along with provision of fertilizers (DAP & Urea) under the AII project. Agriculture experts were engaged to monitor the activity and trained the farming community of the locality. Awami welfare society (AWS) was in close contact with Agricultural research institute (North) Mingora Swat and experts were also provided by this Agricultural research institute.

Sowing was carried out one month later than the most favorable time for sowing in upper swat. Plot size 3 m x 4.5 m used. The optimum sowing time at high elevations in Swat-Pakistan started from May 15th, to June 15th whereas the crop were sown on July 15th 2013. All agronomic practices were maintained in a well reputed manner. The parameters studied and data were recorded during the AESA (Agronomic Ecosystem Analysis) was days to tasseling, days to harvest, Weeds density 25 DAS, Weeds density 50 DAS , Weeds density 75 DAS , cob length (cm), plant height (cm), grains cob^{-1}, 1000 grain weight and grain yield (kg ha^{-1}). Day to tasseling and silking was calculated from the date of sowing to 50% tasseling and silking. Plant height was measured at the levels of harvesting. Plant height was measured from ground floor of the selected plants with the help of measuring tape and then averaged. Four central rows harvested in each sub plot and after shelling of the rows grain yield was recorded and then converted to kg ha^{-1}. After harvesting, three cobs were taken randomly in each sub plot and number of grain cob^{-1} was calculated and then average. After shelling of ears, thousand grain taken from a large number of seeds and weighted.

The collected data were analyzed statistically using a relevant procedure according to randomized complete block design upon significant F-Test. Least significance difference (LSD) test ($P < 0.05$) was used for mean comparison of the various treatment to identify the significant components of the treatment means (Jan et al., 2009).

RESULTS AND DISCUSSION

Days to tasseling

Analysis of the data revealed that days to tasseling significantly affected by compost application. Significant differences were observed in days to tasseling. In temperate region maize crop positively responded to compost application with late sowing. Early tasseling was observed in those plots treated with higher rates of compost (20 Mg ha^{-1}) taken minimum days to tasseling (52 days) whereas tasseling were retarded with the application of 5 Mg compost application taken optimum days to tasseling 55.5 days respectively. Lowest level of compost application enhanced days to tasseling in late sown maize in temperate region. An increase in phonological growth in the corn with a higher rate of application of compost may have increased water holding capacity, nutrients sources and soften the rhizosphere for the development. (Imran *et al.,* 2015). This also might be due to late sowing of maize crop which leads early initiation of the reproductive stage and complete early the vegetative stage. These results are supported by Imran and Khan (2015) and Imran *et al.,* (2015) they concluded that compost application may enhance the growth parameters of lately sown maize crop. Seed rate used 10 and 30 kg ha^{-1}showed early tasseling which taken minimum days to tasseling (52 days) while the optimum duration of tasseling were observed in 40 kg of seed ha^{-1}applied plots. The reason could be that minimum and optimum seed rate received frequent nutrients uptake, light, aeration and optimum space for roots initiation and elongation. Optimum availability and utilization of nutrients proliferate growth, yield and yield contributing parameters (Imran *et al.,* 2015). These results were confirmed and supported by those of Imran and Khan (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop. The reason could be that in highest seed rate competition for light, nutrients, water, CO_2 and others essential requirements for plants can increase days to tasseling.

Days to silking

The data revealed that the days to silking was significantly influenced by compost application. Minimum days (57) taken to silking initiation was observed in those plots treated with highest rate of Compost (20 Mg ha^{-1}) application. Delayed tasseling was noted with minimum rate of compost application of 5 Mg ha^{-1}. An increase in phonological growth of corn with higher rate of compost may have increased water holding capacity, nutrients availability and may have soften the rhizosphere for the development of roots (Imran and Khan., 2015). This also might be due to late sowing of maize which leads early to initiate the reproductive stage and complete early the vegetative stage (Imran. 2015). These results were supported by Imran and Khan (2015) they concluded that compost application may enhance the growth parameters of lately sown maize crop. These findings were confirmed and supported by those of Imran et al. (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop. Substantial influence was observed with the application of various seed rates. Earlier silking was observed in seed rate treated with 30 kg ha^{-1} while others have comparable not significant influence in this order. These results were supported by Imran and Asad (2015) they concluded that compost application may enhance the growth parameters of lately sown maize crop. Rapid plant growth and development with the highest level of compost application probably might be frequent supply of nutrients to the crop plant and might be by the microbial activities with the incorporation of compost to the soil. The reason may be that the minimum and optimum seed rate received frequently nutrients availability and uptake, light, aeration and optimum space for roots initiation and elongation and utilization of these components by plant. These findings are closely related to Sarir *et al*., (2005).

Weeds density after 25 days of sowing (m^{-2})

Perusal of the data regarding weed density after 25 days of sowing (ADS) showed that weeds density significantly influenced by compost application. Maximum weeds m^{-2} was recorded with compost application at the rate of 20 Mg ha^{-1} followed by statistically at par 15 Mg compost applications. Lowest weed density m^{-2} was recorded in compost application at the rate of 5 Mg ha^{-1}. This might be due to inappropriate time of sowing with the application of highest rate of compost which provides luxurious growth to weeds as compared to economic crop (Imran and Khan., 2015). Lately sown maize suppressed by the weeds due to its optimum time for growth and development. As the level of compost increased a linear increase was recorded in weeds density. This might be due to increase in weed seeds with compost level and might be due to pre emerged weeds which have well established root system which utilize compost for their growth, maintenance and their survival (Imran, 2015) and (Imran and Khan., 2015). In case of seed rate highest weed density was recorded in those plots treated with 10 kg ha^{-1} followed 20 kg seed rate ha^{-1}. The lowest weed density was recorded with the application of 40 kg seed ha^{-1}. As the seed rate increased a linear decrease was recorded in weed density m^{-2}. The reason could might be due to highest plant population which decrease the competition of weeds with economic crops through there shading and occupying of space which leads the economic crop dominant over the weeds (Imran and Khan., 2015). These results were confirmed and supported by those of Imran et al. (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop.

Weeds density after 50 days of sowing (m^{-2})

Weeds density after 50 day of sowing responded positively to compost application and seed rates. The analysis of the data revealed that highest weeds density m^{-2} was recorded in compost application at the rate of 20 Mg followed by at par 15 and 20 Mg compost application. Minimum weeds density was noted in compost treated plots at the rate of 5 Mg ha^{-1}. The lowest weeds per square meter were statistically at par with 5, 10 and 15 Mg compost application. This might be due to inappropriate time of sowing with the application of highest rate of compost which provides luxurious growth to weeds as compared to economic crop (Imran et al., 2015). Lately sown maize were suppressed by the weeds due to its optimum time for growth and development. The reason could be that compost provide organic matter and other essential nutrient to the plants which also get by the weeds. This also might be due to increase in weed seeds with compost level and might be due to pre emerged weeds which have well established root system which utilize compost for their growth, maintenance and survival (Imran, 2015). In case of seed rate maximum weed density was observed at the rate of 10 kg ha^{-1} followed 20 kg seed ha^{-1}. Minimum weeds density m^{-2} was noted in 30 and 40 kg seeds application having at par value weeds density m^{-2}. As the seed rate increased a linear decreased was observed in weeds density m^{-2}. The reason could be that plant population drastically decreases weeds density m^{-2} through high and dense vegetative growth which suppresses the weeds and weeds become under shading which cannot get optimum light for photosynthesis, nutrient uptake, water absorption and leads the weeds to suppress (Imran and Khan., 2015).

Weeds density after 75 days of sowing (m^{-2})

Compost application at the rate of 15 and 20 Mg ha^{-1} produced at par value weed density m^{-2}. Compost application at the rate of 10 Mg ha^{-1} produced correlated valued weed density with 15 Mg compost treated plots. Minimum weeds density m^{-2} was noted in compost treated with 5 Mg ha^{-1}. Weed density was increased with the time period. This might be due to increase in weed seeds with compost level and might be due to pre emerged weeds which have well established root system which utilize compost for their growth, maintenance and their survival (Imran, 2015). This might be due to inappropriate time of sowing with the application of highest rate of compost which provides luxurious growth to weeds as compared to economic crop (Imran and Khan., 2015). Lately sown maize were suppressed by the weeds due to its optimum time for growth and development. The reason could be that weeds attain maximum photoperiod and optimum temperature for seed germination (Imran et al., 2015). In case of seeds rate highest weed density m^{-2} was observed in 10 kg seed ha^{-1} application followed by 20 kg seeds treated plots. This might be due to minimum population m^{-2} which allows weeds growth and development in their respective regions (Imran and Khan., 2015). Minimum weeds density was noted in 30 and 40 kg weeds m^{-2}.

Cob length (cm)

Optimum cob length was observed with compost application @ 20 Mg ha^{-1}while the rest of compost application was at par. The increase in cob length might be optimum levels of compost and seed rate application. These results were confirmed and supported by those of Imran and Khan (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop. It proliferate nutrients absorption, translocation and assimilation of photosynthates by providing essential plant nutrients which play their role in physiological processes of the plant (Imran et al., 2015). Compost application enhances water holding capacity of the soil through which nutrients absorption occurred to the inhabitants' plant because of the mass flows of nutrients and diffusions. Sahoo and panda (2001), Imran and Khan (2015), also reported that length of cob increases with frequent supply of nutrients. These results were confirmed and supported by those of Imran and Khan (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop.

Plant height (cm)

Compost, seed rate and interaction between S x C significantly affected plant height. Maximum (190.83 cm) plant height noticed with the application of compost @ 20 Mg ha^{-1} followed by plots received compost at the rate of 15 Mg ha^{-1}. Consequential plant height was recorded 182 cm with application of compost at the rate of 20 Mg ha^{-1}while minimum height of the plants (167.58 cm) were observed with the application of compost used 5 Mg ha^{-1}. Linear increase was noted in plant height with Compost levels. These results were confirmed and supported by those of Imran and Khan (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop (Imran and Khan., 2015). Seed rates also influenced plant height and taller plants were noted in all seed rates having at par value in this order. The interaction indicates that short plants observed in 10 kg of seed sown ha^{-1} (170.67) with the application of 5 Mg of Compost application. Compost increased up to 20 Mg ha^{-1} produced higher plants (195 cm) treated with seed sown at the rate of 40 kg ha^{-1}. The results are with conformity with those of Khaliq *et al*. (2004) they concluded that plant height increased by increasing and incorporation of organic matter in the soil. These results were confirmed and supported by those of Imran and Khan (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop.

Grains cob-^{1}

Number of grains cob^{-1} showed positive response to compost application. Optimum grains cob^{-1} (grain 381.5 cob^{-1}) noted with the highest levels of Compost (20 Mg ha^{-1}) application followed by 15 and 10 Mg ha^{-1} treated plots (377 and 363 grains cob^{-1}). At least grains per cob (346) were observed in those plots treated with Compost @ 5 Mg ha^{-1}. Seed rate significantly affected the number of grain cob^{-1}. These results were confirmed and supported by those of Imran and Khan (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop (Imran et al., 2015). Maximum grain cob^{-1} were recorded in the plots treated with 30 kg seed rate ha^{-1} (375.42 grain cob^{-1}) followed by 20 and 40 kg seed ha^{-1} (369 and 365 grain cob^{-1}). Minimum grain cob^{-1} was observed with the application 10 kg seed rate ha^{-1} (358 grain cob^{-1}). The interaction between S x C indicated that the minimum grain cob^{-1} was observed in 10 kg of seed rate ha^{-1} while a maximum of 398 grain cob^{-1} were observed in 30 kg of seed ha^{-1} with application of Compost at the rate of 15 Mg ha^{-1}. These results are followed by those of Khan *et al*. (2008) who reported that organic fertilizers applications significantly affected grain cob^{-1}. These results were confirmed and supported by those of Imran and Khan (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop (Imran et al., 2015).

Thousand grains weight (g)

Grains weight responded positively to seed rate and compost application while the interaction between S x C had not significant affect. Optimum grain weight (203 g) were observeved in plots received compost @ 20 Mg ha^{-1} followed by 15 and 10 Mg compost application. Lowest thousand grain weight was recorded with Compost application @ 5 Mg ha^{-1} (171.58 g). This might be due to optimum nutrients absorption and translocation into the sink which resulted in the highest weight of grains (Imran et al., 2015). These results were confirmed and supported by those of Imran and Khan (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop. Similarly the seed rates had significant effect on 1,000 grains weight and highest 1000 grain weight was recorded at 40 kg seed rate ha^{-1} (192.83 g) while other seed rates were comparable at par respectively. The reason of highest 1000 grain might be due to optimum nutrient absorption, highest nutrients mass flow due more water holding capacity of compost incorporated soil which enriched the root zone for maximum absorption of nutrients. These findings were strongly agreed with those of Saleem (1990) who reported that the use of farmyard manure (FYM) in to the soil not only supplies the Phosphorous but increase the availability of natural nutrients. These results were confirmed and supported by those of Imran and Khan (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop.

Grain yield (kg ha^{-1})

Application of compost along with various seed rate significantly influenced grain yield. The interaction between S x C was found significant. Optimum grain yield was noted with the application of compost @ of 20 Mg ha^{-1} followed by the rest of levels. Highest grain yield (2318 kg ha^{-1}) were recorded in those plots treated with Compost at the rate of 20 Mg ha^{-1} followed by 15 Mg ha^{-1}(2068 kg ha^{-1}) while minimum grain yield was recorded @ 5 Mg ha^{-1} compost application. These results were confirmed and supported by those of Imran and Khan (2015) they reported that compost application along with different seed rate and plant population influenced phonological characteristics of maize crop. Increase in grain yield with highest level of Compost application might be due to increase in the cob length, number of rows per cob, number of grains per cob and thousand grain weights. Minimum grain yield was found with the lowest level of compost application at the rate of 5 Mg ha^{-1}. The response of maize in term of high yield indicated higher demand for compost application. (Hussanin and Haq, 2000) and Ibrikci *et al.* (2005) suggests that the organic matter and Compost fertilizer is a rich resource of NPK nutrients and the deficiency of these nutrients are the basic crop growth and yield limiting factors. These results were confirmed and supported by those of Imran and Khan (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop. Grain yield responded to seed rate. Optimum grain yield (2712 kg ha^{-1}) was observed with the application of 40 kg ha^{-1}. Minimum grain yield (1334 kg ha^{-1}) was recorded in 10 kg of seed ha^{-1} treated plot. Higher grain yields can be achieved by proper seed rates and right agronomic practices. Interaction showed non-significant differences in the outcome of grain yield. Minimum grain yield was recorded in those plots which received 10 kg of seed ha^{-1}. Grain yield significantly influenced by seed rate and plant population which leads to optimum plant per unit area. These results were confirmed and supported by those of Imran and Khan (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop. Grain yield linearly increased with the increase in seed rate. Increase in grain yield with highest level of Compost application might be due to the increase in cob length, number of rows per ear, number of grains per ear and thousand grain weight. These results were confirmed and supported by those of Imran and Khan (2015) they reported that compost application along with different plant population and seed rate influenced phonological characteristics of maize crop.

Table-1. Days to tasseling, days to silking, weeds density after 25, 50 and 75 days of sowing(DAS) as affected by seed rate and compost application

Compost (Mg ha^{-1})	Days to tasselling	Days to silking	Weed density 25 DAS	Weed density 50 DAS	Weed density 75 DAS
5	54 50 c	59.83 c	70c	91bc	112c
10	53.83 b	58.41 b	74b	92b	124b
15	52.83 A	58.00 b	75b	97b	127ab
20	52.00 a	56.75 A	84A	104a	136a
LSD$_{(0.05)}$	0.84	0.60	3.43	6.27	11.41
Seed rate kg ha^{-1}					
10	52.58 A	58.33 b	92a	108a	141a
20	53.33 A	58.83 b	86b	97b	118b
30	52.58 A	57.50 a	81c	83c	93c
40	54.25 B	58.33 b	72d	81c	86c
LSD$_{(0.05)}$	0.84	0.60	3.43	6.27	11.41
Interaction S X C	1.68	ns	ns	ns	ns

Table-2. Plant height, number of grain cob^{-1}, 1000, grain weight and grain yield of maize as affected by the application of Compost and seed rates

Compost (Mg ha^{-1})	Cob length (cm)	Plant height (cm)	Grain cob^{-1}	1000 G wt (g)	Grain yield (kg ha^{-1}
5	16.41 c	167.58 d	346.08 d	171.58 d	1855d
10	17.40 b	174.00 c	363.25 c	179.67 c	1936c
15	17.73 b	182.00 b	376.75 b	190.25 B	2068b
20	19.10 (A)	190.83 A	381.50 a	203.42 a	2318a
LSD$_{(0.05)}$	0.89	1.95	4.59	5.47	100.28
Seed rate kg ha^{-1}					
10	16.83 b	179.5 A	358.08 d	184.42 b	1334d
20	17.51 b	176.83 b	369.42 b	186.00 b	1956c
30	17.48 B	178.92 a	375.42 a	181.67 b	2174b
40	19A	A-179.17	364.67 c	192.83 A	2712a
LSD$_{(0.05)}$	0.89	1.95	4.59	5.47	100.28
Interaction S X C	Ns	3.91	9.19	ns	200.55

CONCLUSION

Weeds density and population in upland environment greatly influence economic crops yield. Therefore to obtained optimum yield of maize crop in these regions the seeds should be used 40 kg ha^{-1} for late sowing of maize with application of compost at the rate 20 Mg ha^{-1} for optimum plant growth, yield and yield contributing parameters.

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