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# Response Of Maize (*Zea Mays* L.) Hybrids To Different Fertility Regimes Under Agro-Climatic Condition Of Dera Ismail Khan

**Najeeb Ullah (Corresponding Author)**
Department of Agronomy, Faculty of Agriculture, Gomal University, Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan Email: najeeb.agri@gmail.com
**Nasr Ullah Khan**
Gomal Centre of Biochemistry and Biotechnology, Gomal University, Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan
**Ata Ur Rehman**
Institute of Biological Sciences, Gomal University, Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan
**Abdul Muqeet Nawaz**
Department of Plant Breeding and Genetics, Faculty of Agriculture, Gomal University, Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan
**Musa Khan**
Government Postgraduate College Dargai, The University of Malakand, Khyber Pakhtunkhwa, Pakistan

## ABSTRACT

Studies on response of maize hybrids to different fertility regimes under agro-ecological environment of Dera Ismail Khan were carried out at Agriculture Research Institute, D.I. Khan in Kharif season 2013. The trail was conducted in RCB design with 3 replication in a split plot manner with a net plot size of 5 m × 3 m (15 $m^2$). The maize hybrids, used were Pioneer 30k08, Pioneer 3025, Aresta1002W and Verbal 505W. These hybrids were evaluated at fertility regimes viz., F1 (200-150-100 NPK kg $ha^{-1}$), F2 (250-200-150 NPK kg $ha^{-1}$) and F3 (300-250-200 NPK kg $ha^{-1}$). Results revealed that different fertilizer levels and various maize hybrids significantly affected the yield and various yield contributing parameters. The maximum plant height of 188.3 cm was recorded in Pioneer 3025 while high germination percentage (98.6%) was noted in Pioneer 30k08 at F2 fertilizer levels. On the other hand maximum crop growth rate (CGR) (38.6 $gm^{-2}day^{-1}$), net assimilation rate (NAR) 780.4 $gm^{-2}day^{-1}$ and relative growth rate (RGR) 6.52 was observed in Pioneer 3025 at F1 fertilizer level. The data regarding grain yield depicted that the maximum grain yield of 9.25 tons per hectare was observed and biological yield of 30.9 tons per hectare was obtained by Pioneer 3025. It is therefore, concluded from the present research that the highest fertilizer dose of 300:250:200 NPK kg $ha^{-1}$and the maize hybrid Pioneer 3025 proved the most profitable combination among all the treatments and hence recommended for agro-climatic condition of Dera Ismail khan.

**Keywords**: Maize Hybrids, Fertilizer Levels, Yield, Yield Components.

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## INTRODUCTION

Maize is a fundamental cereal crop, subsequent to rice and wheat. Its botanical names are *Zea mays* L. whereas its vernacular name is Makkai and its family names is poaceae. It is cross pollinated crop with broad and sturdy stem, having leaf at every node. Its leaf has two parts, sheath and a blade. Male and female flowers are borne in split arrangement on the same plant. The male flowers are borne in the tassel at the apical region of the tail (stalk), whereas the female flowers are situated in spike which terminates on the side branches arising in the axils of inferior leaves. The fully grown pistillate inflorescence is called the ear. The internodes are in a straight line and virtually located cylindrically in the superior region however instead of invagination on the inferior component (Arnon, 1972). It has enormous pecuniary value in poultry and livestock production (Harris *et al.*, 2007). It can be processed for frequent industrial goods for human being use (Ortiz-Monasterio *et al.*, 2007). Maize grain has prominent the nutritive rate as it contains about 10% protein, 5.8% fiber,72% starch, 3.0% sugar, 4.8% oil and 1.7% ash (Chaudhary, 1983). It is widely developed in tropical, subtropical and temperate regions. It is grown through spring and summer seasons. Being a squat interval cereal crop, it has gotten superior preference in the areas of high altitude particularly in the Northern regions of Pakistan. It can be grown on all types of soils, ranging from sandy to clayey. Though medium-textured soil with pH 6.5 to 7.5 is mainly proper for maize. Soil and climatic conditions of Pakistan are ideal for maize production. It contributes a lot to the economy of country, as it is affluent source of food, fodder, feed, and also make available raw materials for the industry. Maize oil contains plenty amount of fatty acid and is hence most suitable for human exploit in place of animal fat which has awful impact on the human health due to existence of saturated fatty acids. In addition, its goods like corn starch, corn flakes, gluten germ cake, lactic acid, alcohol, and acetone are moreover directly consumed as food or used by a variety of industries like paper, textile, foundry and fermentation etc. About 2/3 of the entire world yield of maize is utilized in live stock or for commercial synthesis of starch and oil (Khalil and Jan, 2004). It is approximate that 75 % of the total production of maize is used as food by the farming communities and the remaining finds its manner in starch developed industry, poultry feed and urban food grain sales (Muhammad, 1979).

Maize has an enormous assure of higher yield and simple cultivation than any other cereal crop if managed well, can go a long way in increasing food production in our country. But unluckily, in spite of its great yield potentials, the frequent production in Pakistan is extremely stumpy as compared to the other essential corn developing countries. To obtain improved grain yield, it is necessary to keep optimal number of plants $ha^{-1}$ since it is an imperative feature for controlling weeds and increasing yield. Competition between maize and weeds for nutrients, soil moisture, space and radiation, and extensively decrease both the quality and the quantity of maize (Hussain, 1983). The production of crop although, ranges in different varieties, locations and also changes with the accessibility of crucial aspects as soil nutrient composition and submission of artificial nutrients. The nitrogen is an important nutrient and a chief production and contribution source obligatory for the production of maize (Shanti *et al.*, 1997). Impartial fertilizer is an imperative constituent that play a vital function in raising the crop value and its assembly. For key processes of yield

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formation and plant improvement, the occurrence of essential nutrients in impartial form is obligatory (Randhawa and Arora, 2000).

Nutrient management is one more essential factor of crop production. It is a proper way of managing nutrients level, through which both the quality and quantity of crop could be increased (Mahmood *et al.,* 2000). The present study has been designed to evaluate the role of various doses of fertilizers on maize production and also to observe the adoptability of various maize hybrids under agro-ecological condition of Dera Ismail Khan.

## MATERIALS AND METHODS

The study was carried out at ARI, D.I. Khan in Kharif season 2013. The trail was conducted in RCB design with 3 replications in a split plot manner with a net plot size of 5 m × 3 m (15 $m^2$). The main plots were consist of different fertilizers levels viz. F1, F2 and F3, while the four maize hybrids were kept in subplots. The maize hybrids were sown in mid July by dibbling method in rows 75 cm apart. The plant to plant distance was kept 25 cm. The maize density was kept constant @ 5 plants $m^{-2}$. The whole of the phosphorus and potash and 50 percent nitrogen was added at the time of sowing, similarly the residual 50 percent nitrogen was added at knee height level of crop. All the cultural practices (sowing, weeding, hoeing, irrigations, insect pest control etc) were used same for all blocks. The detail of the experimental treatments is given as under;

Factor A (main plot) fertilizer doses

F1 = (200:150:100 NPK kg $ha^{-1)}$

F2 = (250:200:150 NPK kg $ha^{-1}$)

F3 = (300:250:200 NPK kg $ha^{-1}$)

Factor B (Sub plot) maize hybrids

H1 = Pioneer 3025

H2 = Pioneer 30K08

H3 = Aresta 1002 W

H4 = Verbal 505 W

### Data recording and statistical analysis

Data was recorded on plant height (cm), days to tasseling, days to silking, crop growth rate ($gm^{-2}$ $days^{-1}$), net assimilation rate, biological yield, grain yield and harvest index. The data recorded were subjected to analysis of variance technique appropriate for RCB design with split arrangement as suggested by Jan *et al.,* 2009. Least significant difference (LSD) test was used to observe significant variances among different levels of the treatments and treatment relations (Steel and Torrie, 1980).

## RESULTS AND DISCUSSION

### Plant height (cm)

Figure 1 showed statistically highly significant difference among means of various maize hybrids on plant height whereas fertilizer levels depicted statistically non-significant affects on plant height. Tallest plant height (186.82 cm) was noted in Pioneer 30k08 followed by Verbal 505 w and Pioneer 3025. Shortest plant height was

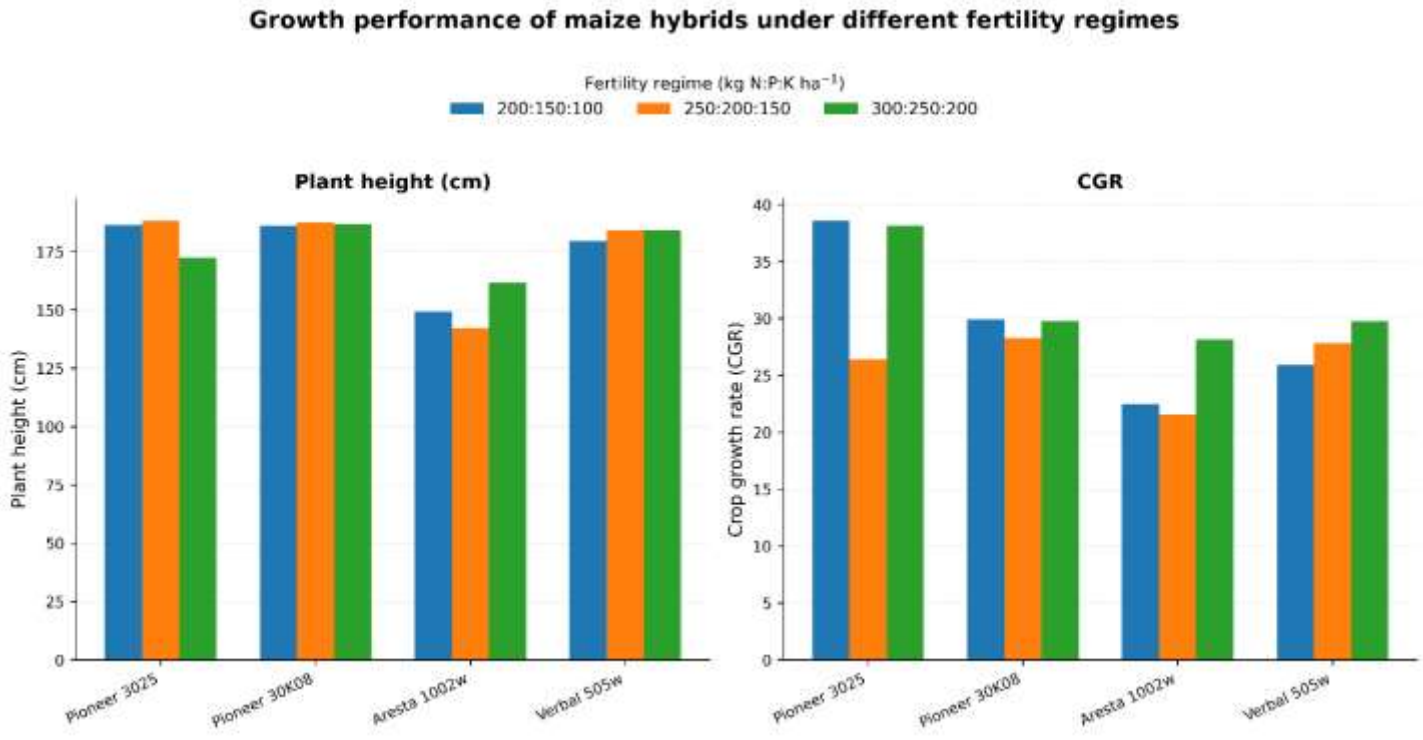
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noted in Aresta 1002 w. The interaction between maize hybrids and different fertility levels are also highly significant. Maximum plant height was recorded in Pioneer 3025 when blocks treated with F2 (250:200:150 NPK kg $ha^{-1}$) fertilizer dose with the value of 188.33 cm which was statistically at par with Pioneer 30k08 treated with F2 (250:200:150 NPK kg $ha^{-1}$) fertilizer and Pioneer 3025 treated with F1 (200:150:100 NPK kg $ha^{-1}$). While minimum plant height (142.10cm) was recorded in Aresta 1002w when blocks treated with F2 (250:200:150 NPK kg $ha^{-1}$). Genetic makeup of maize hybrid could be the reason. Similar results were obtained by Utobo *et al*. (2010) and Ahmad *et al.* (2000) who observed that plant height was significantly affected by cultivars.

**Fig. 1** Plant height and crop growth rate (CGR) of maize hybrids at different fertility regimes under the agro-climatic conditions of D.I.Khan.




with F1 (200:150:100 NPK kg $ha^{-1}$) fertilizer dose. Minimum crop growth rate was (26.16) noted in blocks treated with F2 (250:200:150 NPK kg $ha^{-1}$) fertilizer regimes. Highly significant interaction was observed in maize hybrids and fertility levels for crop growth rate. Maximum crop growth rate (38.60) was recorded in Pioneer 3025 when blocks treated with F1 (200:150:100 NPK kg $ha^{-1}$) fertilizer levels which was similar statistically to Pioneer 3025 when blocks treated with F3 (300:250:200 NPK kg $ha^{-1}$) fertilizer dose. Minimum crop growth rate (21.55) was recorded in Aresta 1002W with F2 (250:200:150 NPK kg $ha^{-1}$) fertilizer regimes. Comparable outcome were too stated by Shearman *et al.* (2005), and D' Andrea *et al.* (2008) effective on wheat and maize, correspondingly. Therefore, the execution of huge sink size throughout growth may be needed for a greater production of corn. Besides the improvement of large sink organ, a large quantity of non-structural carbohydrate collected during growth may be present in

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a state of mobility and could supply to increased grain filling and final grain production. Differences in crop growth rate could be described to difference in the amount of light as well as its value of use (Monteith, 1977; Horrie and Sakuratani, 1985).

**Net assimilation rate ($gm^{-2}day^{-1}$)**

The data examined for net assimilation rate of various maize hybrids at different fertilizer regimes are shown in figure 2. Significant variation for net assimilation rate was noted in different maize hybrids. Maximum net assimilation rate (696.18 $gm^{-2}$ $day^{-1}$) was noted in Pioneer 3025. Whereas minimum net assimilation rate was found in Aresta 1002W with the value of 489.85. Similarly maize hybrids showed significantly different net assimilation rate at different fertility levels. Maximum net assimilation (637.83) was noted in blocks treated with F3 (300:250:200 NPK kg $ha^{-1}$) fertilizer levels. Minimum net assimilation was recorded in blocks treated with F2 (250:200:150 NPK kg $ha^{-1}$) fertilizer dose. Similarly highly significant interaction between hybrids and fertility levels was recorded regarding for net assimilation rate. Maximum net assimilation rate was recorded in Pioneer 3025 when blocks treated with F1 (200:150:100 NPK kg $ha^{-1}$) fertilizer levels which was statically similar with net assimilation rate of Pioneer 3025 at F3 (300:250:200 NPK kg $ha^{-1}$). While minimum net assimilation (439.19) was found in Aresta 1002W when blocks treated with F2 (250:200:150 NPK kg $ha^{-1}$) fertilizer regimes. Upper levels of nutrient formed highly developed LAI which might have ensured more diffusion of light into the covering of crop which in return increased the rate of photosynthesis. It might have suppressed the respiratory losses which could finally result in high net assimilation rate. Besides more spreading of light into the covering of corn, on soil characteristics and growth properties of spring maize

**Relative growth rate (mg $g^{-1}$ $day^{-1}$)**

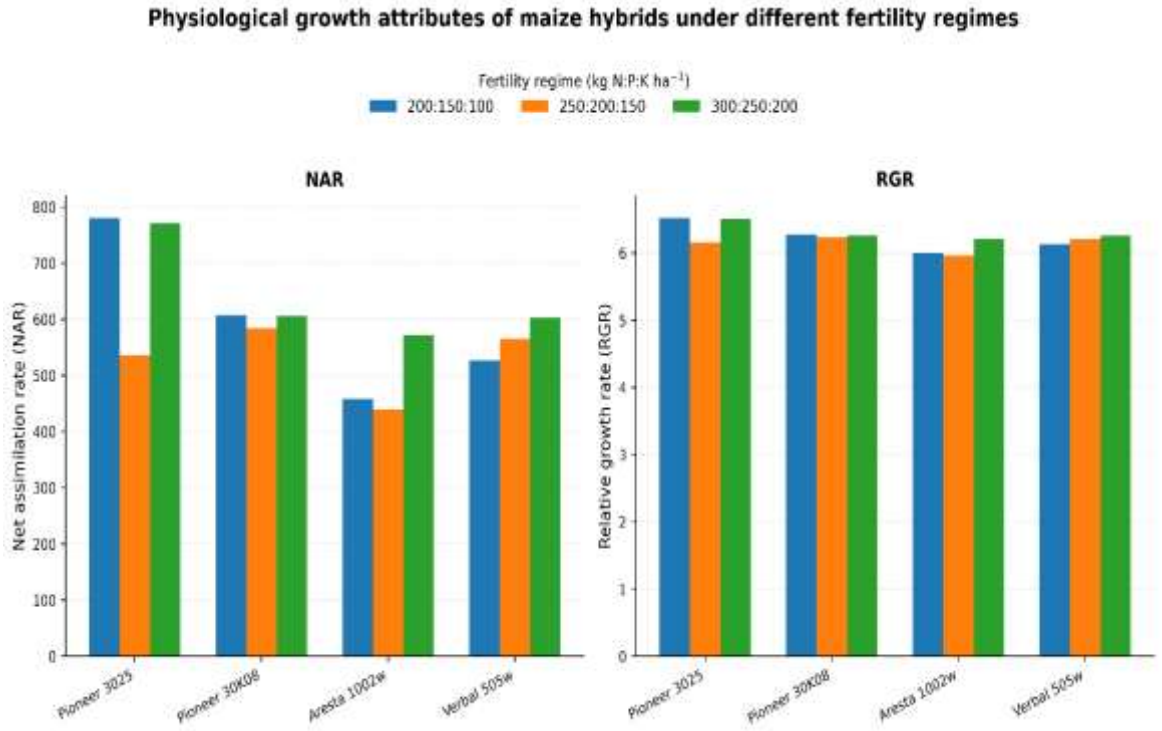
The mean values for relative growth rate as observed in various maize hybrids at different fertility levels are given in figure 2. Statistical analysis of the data showed that highly significant differences among various hybrids were recorded. Highest relative growth rate (6.39) was examined in Pioneer 3025. Whereas lowest relative growth rate (6.06) was noted in Aresta 1002W. The date according to fertilizer level had highly significant influence on relative growth rate. Extreme relative growth rate was calculated in blocks treated with F3 (300:250:200 NPK kg $ha^{-1}$) with the value of 6.13. Least amount relative growth rate (6.14) was noted in blocks treated with F2 (250:200:150 NPK kg $ha^{-1}$). The interactive effect expressed highly significant among various maize hybrids and different fertilizer doses. Pioneer 3025 were leading hybrids with the value of 6.52 as treated with F1 (200:150:100 NPK kg $ha^{-1}$) fertilizer level which was statically at par with Pioneer 3025 at F3 (300:250:200 NPK kg $ha^{-1}$) fertilizer level. Pioneer 30k08 was second hybrids when treated with F1 (250:200:150 NPK kg $ha^{-1}$) fertilizer level.

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**Fig. 2** Net assimilation rate and Relative growth rate (RGR) of maize hybrids at different fertility regimes under the agro-climatic conditions of D.I.Khan.




## Biological yield

Data related to biological yield are shown in figure 3. The analysis of the data expressed that different maize hybrids had highly significantly affected the biological yield. Pioneer 3025 was the main hybrids to produce maximum biological yield (27.73 t $ha^{-1}$) followed by Verbal 505w. While minimum biological yield (22.63 t $ha^{-1}$) was recorded in Pioneer 30k08. The data examined about the fertilizer levels had significantly affected biological yield. Highest biological yield (Table 3) was noted when blocks treated with F3 (300:250:200 NPK kg $ha^{-1}$) fertilizer levels while the lowest biological yield (23.91 t $ha^{-1}$) was found when blocks treated with F1 (200:150:100 NPK kg $ha^{-1}$) fertilizer dose. Similarly significant interaction between hybrids and fertility levels was recorded regarding biological yield. The maximum biological yield (30.90 t $ha^{-1}$) was recorded in Pioneer 3025 when blocks were treated with F3 (300:250:200 NPK kg $ha^{-1}$) fertilizer levels. The minimum biological yield was noted in Pioneer 30k08 when blocks treated with F2 (250:200:150 NPK kg $ha^{-1}$) fertilizer levels. Biological yield is a critical active to decide the photosynthetic efficiency of a crop. Biological yield is variable in various maize varieties (Akmal *et al.*, 2010). Best exploitation of solar light, higher assimilates produce and its alteration to starches showed improved grains weight and number of grains that gave further seed production and biomass (Derby *et al.*, 2004).

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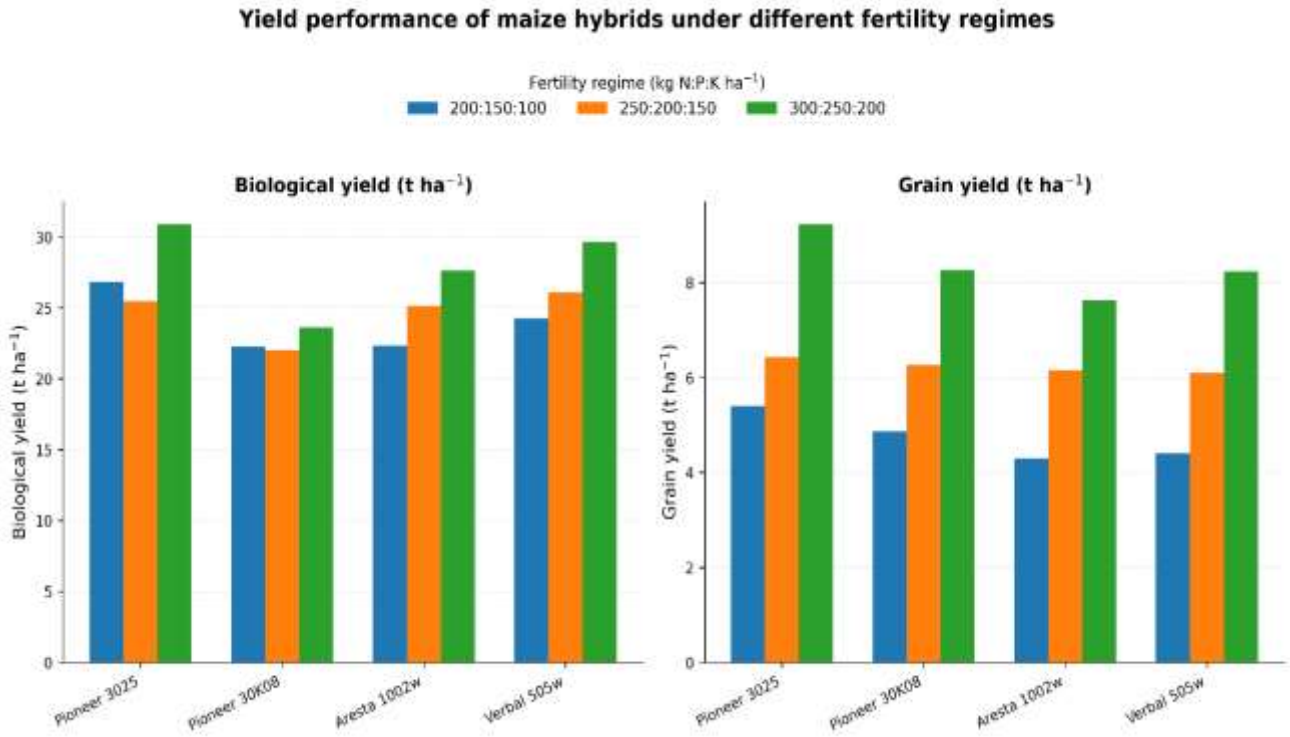
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**Grain yield**

Data for grain yield are shown in figure 3. Highly significant differences were observed in the grain yield as result of various maize hybrids and different fertility levels and their interaction as well. Mean value of the data showed that Pioneer 3025 produced significantly higher grain yield (7.02 t ha$^{-1}$) followed by Pioneer 30k08 with the value of 6.46 t ha $^{-1}$. While Aresta 1002w created minimum grain production (Table 3). Highest grain yield was recorded when blocks treated with F3 (300:250:200 NPK kg ha$^{-1}$) fertilizer levels. Lowest grain yield (4.74 t ha$^{-1}$) was founded when blocks were treated with F1 (200:150:100 NPK kg ha$^{-1}$) fertilizer dose. The interaction between fertilizer rates and maize genotypes was originated significant. Greater grain yield (9.25 t ha $^{-1}$) was found in Pioneer 3025 when blocks treated with F3 (300:250:200 NPK kg ha$^{-1}$) fertilizer levels followed by (8.26 t ha$^{-1}$) Pioneer 30k08 when blocks were treated with F3 (300:250:200 NPK kg ha$^{-1}$) fertilizer dose. The lowest grain yield (4.30 t ha$^{-1}$) was recorded in Aresta 1002w when blocks were treated with F1 (200:150:100 NPK kg ha$^{-1}$) fertilizer levels (Table 3). This may possibly due to the genotype difference between the varaities (Qamar *et al.*, 2007). The results are in distinction with those of Quaranta *et al.* (1998); and Vicente *et al.* (1999) who acknowledged that all hybrids expressed comparable yield. It is same with the statement of Ahmad *et al*. (2000) and Wormer *et al.* (2001) who reported that hybrids vary in their performance to altering soil fertility and ecological position.

**Fig. 3** Biological yield and grain yield of maize hybrids at different fertility regimes under the agro-climatic conditions of D.I.Khan.



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## CONCLUSION

It is concluded from the findings of the present research that maize hybrid 'Pioneer 3025' produced maximum grain yield of 9.25 t $ha^{-1}$ with the fertilizer dose F3 (300:250:200 NPK kg $ha^{-1}$). The maize hybrid (Pioneer 3025) was highly adopted under the autumn planting times at agriculture research institute (ARI) D.I Khan. Therefore, it is highly recommended for the formers of D.I Khan to cultivate maize hybrid Pioneer 3025 for getting maximum grain yield and net return during autumn planting season at D.I. Khan division.

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