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Role of Boron Nutrition on Growth, Phenology and Yield of Maize (*Zea Mays L.*) Hybrids: A Review

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Abstract

Maize (*Zea mays L.*) is one of the most essential cereal crops in Pakistan after wheat and rice. it is used as staple food all over the world because having excellent nutritive value as food for human being as well as feed for live-stock. Boron is a compulsory indispensable element for plant growth and reproduction. It is important for metabolism of carbohydrate and translocation. Maize Hybrids containing genetic purity and identity are responsible for better growth and development, tolerant to disease and pest, comprising seed viability, and germination capacity. Assortment of hypothetically extraordinary growth and yield of maize hybrids which are healthy approachable to fertilizer application are essential implement to enhanced growth, development as well as yield and yield components. The present review directly focuses on the role of boron nutrition on growth, phenology and yield of maize (*Zea mays L.*) and indirectly focuses on the importance of suitable hybrid for improving agricultural crop production.

Introduction

Maize (*Zea mays L.*) is a versatile crop belonging to family poaceae. It is cultivated under both irrigated and rain fed conditions of all the provinces of Pakistan especially Punjab and Khyber Pakhtunkhwa. Maize crop is commonly grown on temperate, tropics and warm sub-tropic region of the world. In our country maize is grown in winter and summer [1]. Worldwide maize is cultivated on an area of 181.03 Million hectares yielding about 5.73 Metric tons per hectare and annual production is 1,037.93 Million metric tons. Maize is the world's third primary cereal crop after wheat and rice grown mostly all over the world mostly for the production of food, feed and fodder. Fodder scarcity is the major dispute for the expansion of livestock industry in Pakistan. It positions third most grown crop in the world with an area of more than 118 million hectares with yearly production of about 600 million metric tons. In Pakistan maize is the fourth largest grown crop after wheat, cotton and rice. Maize was cultivated on an area of 1.15 thousand hectares in 2015-2016. It shows an increase of 5.4 % over last year's area of 1.10 thousand hectare. The production of maize stood at 5.20 Million metric during 2015-16 showing an increase of 7.3 percent against last year production of 4220 thousand tonnes. The area under maize is over one million hectares and production 3.5 million metric tons. Punjab subsidizes 39 percent of the total area under maize and 30 percent of total production. The KPK subsidizes 56 percent of the total area and 63 percent of the production whereas five percent of the total area and three percent of the total production is received from Sindh and Baluchistan [2].

Boron is a compulsory indispensable element for plant growth and reproduction. It is important for metabolism of carbohydrate and translocation [3] and also plays a vital role in materialization of cell in plants, Integrity of plasma membrane and encouragement of fertilization for seed development [4]. It is essential micro nutrient responsible for enhancing the production of nectar in flowers, and thus to increase the attractions of insects for pollination. Furthermore, boron has played important role in the cell structure and also plays a vital role in materialization of cell in plants. Pollen tube growth, integrity of plasma membranes and encouragement fertilization for seed development [4].

Maize Hybrids containing genetic purity and identity are responsible for better growth and development, tolerant to disease and pest, comprising seed viability, and germination capacity. Assortment of hypothetically extraordinary growth and yield of maize hybrids which are healthy approachable to fertilizer application are essential implement to enhanced growth, development as well as yield and yield components [5]. Maize hybrids perform better growth and yield and also resistant to pest and disease the application of boron is necessary for maize crop for better growth because the deficiency have observed in calcareous soil [6]. The present review directly focuses on the role of boron nutrition on growth, phenology and yield of maize (*Zea mays L*.) and indirectly focuses on the importance of suitable hybrid for improving agricultural crop production

Effect of boron on growth, phenology and yield

Boron is a compulsory indispensable element for plant growth and reproduction. It is important for metabolism of carbohydrate and translocation and also plays a vital role in materialization of cell in plants. Pollen tube growth, integrity of plasma membranes, and encouragement fertilization for seed development. [7] studied the influence of exogenous application of boron as (boric acid) on growth parameter as nutrient contents in flowers and leaves. They accomplished to apply boron at concentration of 0, 5 ppm, 10, and 20 ppm. Result showed that the Exoganic spray of boric acid at all level and the combinations noticeably improved growth perameter flowers characteristics and yield per plant. The treatments considerably enhanced leaves, leaves carbohydrate, nutrient, pigment i.e. N, P, K, Z, Mn, Fe and B content as well as oil in flowers and carbohydrates and nutrients in the control treatment and the resulted from boric acid performance with Zn at 4.5 g with combined boron of 20 ppm.

[8] suggested that influences of exogenous application of micronutrient boron as boric acid. The obtained result showed that the 3 kg ha-1 level of foliar applied boron increase plant height, cob length, bio mass and yield of maize significantly increased with the application of boron. Boron 3 kg ha-1 significantly increased grain yield as compared to control i.e., treatment which have no boron application. It's concluded that boron at 3 kg ha-1 is optimum dose for normal growth and yield of maize crop. It is expected that soil contain colemanite (Boron) and its optimum level present positive effect on maize crops. [9] Exposed his study to determine the impact of exoganic spray of boron on different growth stages of maize. Experimental results showed that the concentration of boric acid (0.5%) boron produced good results when applied in early middle and late stages to taller plants (195.05 cm), i.e., more number of green leaves (8.00) plant-1 thicker stem width (5.21), more fresh (58.04 t ha-1) and dry fodder yield (17.59 t ha-1) less number of dry leaves (3.00) plant-1. Basel applied boron has not resulted better as compared to foliar application. It can be concluded from the study that for getting higher fodder yield of maize at early, mid and late application of B (0.5%) as exoganic spray of boron could be applied.

[10] Examined the response of foliar application of boron on maize crop growth and yield. The results showed that significant phosphorus contents accumulated by both boron foliar application and water stress. Boron concentration significantly varied in stress levels. Activity in stress levels affected the stem amylase of boron application and the stress levels and boron foliar application showed non-significant result. The concentration in stem amylase affected by stress levels indicates non-significant result. While all the stress levels showed significant result which increase stem protein concentration with application of foliar boron. The concentration of stem protein showed non-significant result as affected by stress levels. While boron concentration increases total soluble sugar in stress while interaction among the applied foliar boron and stress levels was non-significant. [11] Demonstrated that application of boron increased shoot leaf per plant and gave an estimated value as of boron in tissue leaf content amount to 20.61 mg kg-1 while boron plant shoot tissue content amounted to 13.43 mg kg-1. Boron content was 1.02 mg kg-1 but reduced tissue Zn, Fe, and Cu content. It is concluded that sufficient application of boron (7.7 kg ha-1) for soil is best to raise soil B levels to non-deficient levels.

[12] Conducted an experiment to determine the influence of boron concentration and Silicon concentration and its combined concentration on growth and yield of maize cultivar. Boron level was applied at the concentration of 50 and 100 ppm and concentration of silicon at 250 and 500 ppm and their combine concentration were applied. To evaluate the response of growth character, biochemical component and yield component, two samples were taken at interval of 90, 105 days. The obtained results showed that B and Si treatment were more effective than sole treatment, and produced high plant high number of leaves, dry shoot weight, high ear length, chlorophyll reading, grains weight per plant, weight of 100 grains, plant height, ear length, total soluble sugars and proline. Boron at the rate of 100 and 500 ppm in maize crop have the stimulating effect on the growth, biochemical component and yield of maize crop. [13] studied the influence of foliar application of boron with humix. The obtained results showed that the

humix foliar treatment on plants and pre-sowing treatment had increased the number of rows and the control had not significant results. The highest grains yield in foliar humix application and also increased 1000 grain ha-1. While the control treatment produced lower 1000 grain ha-1. The pre-sowing treatment with Nitroxin were high and lowest value in control. Humix applied as foliar had the highest mean value (30554 kg ha-1) of biomass yield of plant successively. The yield and component of yield of maize crops increases with the foliar application of Humax treatment during early sowing maize crop. [14] conducted experiment to determine the performance of maize hybrid influence by foliar applied boron. Boron concentration was used at the concentration of (0, 5, 10, and 20 ppm) on the growth and yield of Zea mays L. The result showed that the excess growth through boron application and the excess amount of K showed negative impact on plant growth. The excess application of boron observed in shoots more than root of plants. The increase concentrations of boron reduce the concentration of potassium in the shoot. However, the application of boron on hybrid maize plants has positive impact on growth and yield component.

[15] evaluated the effect of boron and zinc and iron on rice crops the result showed that maximum plant height, panicle grain kg ha-1, paddy yield, 1000 grain yield and maximum, number of panicle per meter square had drastically increased with the application of combined micro-nutrient. Panicles per meter square were recorded maximum with application of zinc. The concentration of foliar applied boron showed higher yield as compared to zinc and iron [16] determine the performance of foliar application of boron on growth and yield of brinjel ratoon crops. The obtain result indicate that 70% increment occur in plants flowers, buds, 141% improvement in number of cluster, 30% increase in fruit set, fresh weight fruits 88% with application of boric acid with concentration of 150 ppm. However, the H3BO3 boric acid among 150 ppm concentration were best for brinjel ratoon crops during the flower initiation stage for better performance and well crop growth and yield. [17] conducted an experiment to examine the impact of exogenous application of boron on maize parameter. Including three treatment of boron such as control, 3 and 6 kg ha-1 were applied and Zn has three treatments (0, 8, 16 and 24 kg ha-1). The finding result showed that boron application result in significant response while the Zinc application strongly affected plants leaf significantly. The soil added zinc had non-significant result while the boron soil addition hade positive results. Zinc application reduced the boron content while zinc applied also proved insignificant. But the exogenous applied boron enhanced the zinc content of leaf. [18] examined the impact of boron and zinc on fertilization of crop growth, yield, nutritional value, dry matter, and nutrient accumulation. The obtained result showed that the application of boron and zinc with fertilization were enhances the growth but forage were no significant increase of nutritional value. But the accumulation and absorption of nutrient concentration in the tissue of plants resulted from application of boron and zinc highly significant .Concluded that the use of boron had substantial effect on the yield of maize crop. The deficiency of boron and zinc is prevalent in calcareous soils. It was suggested that basal application of boron at the rate of 15-25 kg ha-1 to the maize field could enhancement growth and yield maize crop.

[19] Demonstrated of exogenous application of boron after 20 days interval of crop emergence at 0, 0.15, 0.30 and 0.45 kg boron ha-1. Plant height, stem diameter, cob weight, leaf area, protein content, number of grains per cob, and oil content were increased with boron application at the rate of 0.30 kg ha-1. The maximum grain yield (7.15 tons ha-1) and biological yield (530 tons ha-1) were recorded in B2 with concentration at 0.30 kg ha-1 was applied. Nevertheless, further increase in B application dose can decrease the grain production. [20] Stated that the application of boron with recommended dose of nitrogen enhanced crop growth and development. Boron at the rate of 6 kg ha-1 combined with nitrogen at the rate of 120 kg ha-1 increased number of cob per plant, number of grain rows per cob, cob length, grain yield and biological yield compared with boron application at the rate of 3 kg ha-1 with recommended dose of nitrogen (60 kg ha-1). [21] Carried out an experiment to investigate the effect of boron on growth and yield of maize and black grams with recommended dose of NPK fertilizer. The study showed that applied boron at the rate of 10 kg ha-1 significantly result increased dry matter and pod production along with grain yield and biological yield. Boron application 5 kg ha-1 showed insignificant results with recommended dose of NPK. Applied boron at the rate of 50 kg ha-1 with zinc at the rate of 50 kg ha-1 showed the highest grain yield of maize and black gram crops. [22] Observed that the exogenous single addition of multi-nutrient with recommended dose of NPK boosted the yield of maize. All growth parameter and also macronutrients consumption productivity increased up to 11.5% which encouraged substantial proliferation in grain harvest as compared with control. The application of micro nutrient improved the quality of maize along with recommended fertilizer dose. [23] Conducted an experiment to assess the influence of boron application on the growth and yield of rice cultivars. The result showed that increasing level

of boron concentration increased the leaf boron content. Shaheen basmati had higher grain yield and grain weight along with leaf boron content than super basmati. The application of boron improved foliage, yield and grain size while panicle sterility declined.

[24] Observed that application of boron enhanced number of grains per plant of sunflower. The significant result was noted with boron foliar application at the rate of (200 mg. L-1) at flowering stage. Hybrid 55 performed letter than S-278 and patron 851with exogenous spray of boron at flowering stage at the rate of (200 mg L-1) for better production mostly in arid and semi-arid region. [25] Concluded that application of boron @10 kg ha-1 significantly increased the hundred seed weight, number of pod per plant, grain per pods, and 1000 grain weight of wheat crop as compared to control treatment. [26] Conducted an experiment to evaluate the effect of boron toxicity on germination imbibition of maize crop. Using 3.6 g boron with the recommended rate of NPK improved growth of maize crop. The studies revealed that the application of boron increased the germination as well as plant height, leaf area length, shoot length and grain per cob, and yield weight per hectare. [27] concluded that the application of boron boosted growth rate with higher plant growth and increases net assimilation rate. The micronutrient except boron showed non-significant results as well as combined boron shows a significant result of number of productive tillers, number of grains per spike, and grain yield.

[28] demonstrated that the soil application integrated with exogenous spray of boron at the rate of 1% at 25 and 50 DAS boosted growth and yield component and high economics profit of maize crop due to increase nutrient use efficiency of boron and zinc under rainfed situation among soil treatment with recommended dose of potassium and NPK boosted growth and yield attributes as compared to soil application. [29] suggested an experiment to investigate the response of maize growth and yield with exogenous application of micro nutrient. Treatment examined for seven micro nutrient foliar applications on leaf, seed-filling, and tasseling stages. The obtained data showed a significant response of foliar application on different stages of maize growth and yield. Advance study investigated that mixture of combination with exogenous application of boron of all growth stage highest result of nitrogen reserve. The exogenous application of boron at all growth stage of maize crop produced highest seed (9 mg) these study formed a significant result for all growth stages of maize specially in tasseling stage the highest reserved seed of maize crop. [30] investigated the different fertilizer composition for the positive effect of maize cultivar. The result revealed that maximum cobs per plant, number of grains per cob and 1000 grain weight was obtained from the plot where 100 kg nitrogen per hectare was applied. Organic fertilizer increases the yield of maize when combined application of nitrogen fertilizer was applied as compared to control treatment.

[31] Demonstrated that boron fertilization improved the growth and development of corn crops with the rate of 7-liter ha-1 boron concentration. The combination of organic fertilizer with micro-nutrient fertilization increased grains of corn crops. The obtained result showed the application of foliar boron fertilizer with organic fertilizer improves crops growth and development while maximize grain yield and yield weight per hectare of corn production. [32] Studied the function of boron effect on structure of plants. The study of these research showed that boron is responsible for growth and development of shoot, leaf, roots and plant height. [33] Stated that the physiological and genetic variation occurred due to high concentration of boron. These types of changes of boron in plants structure seen in some species of crops but some of these species were tolerant and some of these crop species reduced uptake of boron in roots and shoots. Some species of crops are responsible to control the uptake of boron due to major gene and chromosomes. The species of some crop plants were identified during population genetic breeding for control of toxicity of boron to reduce the uptake of boron by crop plant. [34] Demonstrated that the growth, dry matter yield, and biomass of corn plant delay in soil having limited boron and zinc availability. Toxicity in plant roots and accumulation of born were noticed particularly in Zn scarce soils. As a consequence, B application proved harmful for the dry matter harvest of maize plant in this revision.

[35] Investigated the effect of boron and copper on rice growth and development. The exogenous applications of Boron and copper improved rice yield by 26% below field dressing. The yield improvement was attributed to a higher proportion of grain with heavier thousand-grain weight. Furthermore, the foliar application factor was also formed to successful to decrease disease occurrence by 4% and this is supposed to be due to the biocide result of Copper and the improvement of the physical growth of the plants such as healthier lignification and encouraged cell membrane which is the main protection device to figure up plants tolerance.

[36] examined the application of B at different rate i.e., 1, 1.6, 2.06, 2.8 and 3 kg boron ha-1. The results presented that use of boron fertilizer increased biological yield and growth

yield of cotton plants. Highest dry matter yield was attained by applying of 3.0 kg B ha-1. The improved acclimatization of macro-nutrients brings about in better creation of healthier growth, biological yield and development of cotton plant. Found that boron application enhanced leaves elongation, tiller per plant, and chlorophyll matters in leaf, water relatives, grain produce, yield-related characters and grain matters with concurrent decline in panicle infertility. Conversely, greenery use of 0.32 M boron was the greatest operative in this respect. Intensification in grain B contents and leaf was perceived with rise in boron absorption in the exogenous spray. Here observed no change among the two varieties for grain yield; conversely, Basmati shaheen had maximum grain and grain weight, and grain and leaf boron concentration than Basmati super. The application of born at the rate of (0.32 M B) showed an operative manner to precise B shortage in rice. Development in grain and grain yield by boron exogenous application was credited to raise size of grain and delay panicle infertility. [37] Demonstrated that hybrids have shown different response to B applications. The cultivars AS-615 and Cuban produced seed yield of 3.70 and 3.20 t ha-1 at 7.5 kg B ha-1 while S-286 and TR- 4090 yielded 4.18 and 3.26 t ha-1, at 0 kg B ha-1. For AS-615 and Cuban, use of 7.5 kg B ha-1 was found enough for reasonable grain yield, however further boron application damaging impact on grain yield.

[38] Concluded the foliar application of boron on cotton crops grown on silt loam soil increases boll per plant, shoots length, leaf area significantly. Foliar application of boron at the rate of 0.11 kg ha-1 enhanced plant growth and yield component and bio mass of cotton crops. Boron was applied three times at the rate of 0.11 kg ha-1 and foliar application two time intervals. But the recommended dose of boron increases the boll formation and growth attributes. It is recommended that the application of boron on silt loam soil both foliar and Basel application could recover deficiency of boron in cotton crops and enhance growth and yield if cotton crops. [39] Evaluated the response of nitrogen and boron on phenology, growth and yield of different cultivar of maize crops. Hybrid of maize "Pioneer (SS-2525)" was exposed to 4 level of N (0, 250, 300 and 350 kg ha-1) and boron (0, 10, 20 and 30 kg ha-1). The result showed that nitrogen and boron application improved growth and yield and quality of maize. Lowest no of days for 50 % tasseling (40.5) and silking (45.1) were recorded when 25 kg boron was applied. In circumstance of combined N and B, lowest days to silking and 50 % tasseling were (45.3 and 40.3) along with application plant (232.3 cm), no of grains cob-1 (523.6), thousand grain weight (321.0 gm), grain yield weight (7.9-ton ha-1) and protein contents (8.9 percent) were observed in N3B3 level (350 kg N and 25 kg boron). The exogenous boron application (treatment B3) at together asexual and anthesis periods had enhanced the yield components and for head width (15.79 cm), biological yield (10063 kg ha-1), achene yield (2008 kg ha-1) and thousand achene weight (40.74 g). Our consequences exposed that the foliar application of boron and irrigation levels improved growth, yield and yield components. Exogenous application of boron at both asexual and anthesis stages better sunflower yield.

Effect of Hybrids on Growth, Phenology and Yield

The present studies revealed that the response of different maize hybrids to the application of boron exceeded the plant height, leaf area index, stem girth and growth and yield through boron at the rate of 15 kg ha-1. These results were received as well management, control of pest and disease, and mostly resistant varieties of maize crop. The population of maize crops ranging from 16000 to 45000 plants ha-1 increase plant height significantly while the local varieties give insignificant results. The hybrid Faraz 26 genotype give the optimum plant height as well as optimum plant population with the application of boron at the rate of 12 kg ha-1. It were concluded that the application of boron along with hybrids increased the plant growth and yield of maize crop. [40] Evaluated the 3 maize hybrids to determine their growth, yield and yield components. It is investigated that the pioneer 30-D-55 exceeded the performance in all of hybrid in this experiment. Analysis of variance showed that the maximum growth and yield of maize was received from pioneer 30-D-55. There were significant differences on hybrid grain yield and biological yield. The optimum grain yield kg ha-1 was observed from pioneer 3012 which is clear from the statistical results. The minimum grain yield kg ha-1 was received from pioneer DAS-3090. Regaling the results the maximum leaf area, biological yield kg ha-1, number of grain per cob, grain yield kg ha-1 enhanced by the maize hybrid such as pioneer 30-D-55. The results reveal that the performance of hybrid on was better to overall hybrid of maize growth and yield attributes.

[41] Carried out an experiment of three maize hybrids to determine the response of exogenous application of boron on maize hybrids growth characteristics, nitrogen substances, mineral such as phosphorous, potassium, boron, foliar boron and soil mixed boron. The maize verity (FH-112) and (sultan) 2.5-5.0 mg kg-1 (soil), and 0.05 mg L-1 (foliar) the range of boron is applied. The obtained result shows that the treatment of boron foliar application enhances the growth and yield of maize crop. [42] Investigated the effect of micro-nutrient on phenology, growth and yield. The obtained results reveal that the micro-nutrient

accumulation of zinc and boron in maize crops enhanced from the copper and manganese uptake. The accumulation of boron is maximum from the current results than the manganese and boron micro-nutrients. The cultivar of corn crops (P-30 F-33 and GNZ-2004) lowered concentration of boron, manganese, zinc in early development stages of plants of corn. While the highest concentration content were obtained from hybrid (P-30) where plant take 100 days after emergence. While the lower concentration of boron were received from hybrid (F-33). In general boron, manganese and copper accumulation is maximum in hybrids P-30 F-33 than GNZ-2004 during the result of this analysis of results. The highest accumulation of boron and zinc during the starting phase of vegetation especially in physiological maturity of maize crops.

[43] Evaluated 13 hybrids of maize to investigate the cumulative impact of both micro and macro-nutrient on quality and yield of maize forage. The factorial experiment is comprised as cultivars and micro-nutrient. The micronutrients and NP application alone and in mixture were conceded with 1 water spray after sowing (DAS) at 10 days, 2 water exogenous application at 10 and 20 DAS and 3 exogenous water sprays at 10, 20 and 40 days after sowing although, mentioned dosage of NP was use control treatment. The experimentation was arranged in RCBD through factorial preparation. The exogenous sprays of micronutrients at 10 and 20 DAS laterally with NP augmenting the forage green biomass (48.53 ton ha-1). The variety Pak Afghoi with 2 exogenous sprays of micronutrients at 10 and 20 DAS along with NP as soil use produced greater green forage (49.52 ton ha-1) and crude protein (8.44 %). For highest yield and protein contented of fodder maize, Pak Afghoi cultivar would be grownup with 2 exogenous applications of micronutrients at 10 and 20 DAS. [44] Studied the 8 different hybrids of maize for enhancing fertilizer use efficiency and water use efficiency in water stress condition of different cultivar of maize crops. The study revealed that the influence of crops biomass and grain yield of maize crops such as mamaba, golden crystal, obatanpa with water stress situation. The three maize cultivar for major and minor crop growing season to evaluate the relationship between dry matter production and water use efficiency. Cropping seasons for all the maize cultivars. The results indicate that each growing season of corn crops the rainfall influence significant impact on harvest index while non-significant results from each specific growing season of corn crops.

[45] Evaluated the response of boron on maize hybrid shoot growth and shoot boron content and uptake of boron by two maize hybrid (Sonari and FHY-396). Plants after forty days were harvested. Dry matter of shoot reduced significantly ($P < 0.05$) with uses of boron due to marked toxicity in leaf damage. The effect of boron induced symptom. In both hybrid absorption and uptake of boron was significantly ($P \leq 0.05$) higher over control with boron application and SAR of irrigation water. The Ca content in shoot reduced with accumulative SAR and boron application. The singularities of boron harmfulness and below Ca patent by lessening in shoot and leaf dry matter of crop with high SAR irrigated with water might be imperative in administration of saline water recycled for crops irrigation on semiarid and arid soil regions. [46] Evaluated maize hybrids (DC-368), (SC-402), and (SC-300) to investigate the reaction of different fertilizer along with better performance of hybrids of maize. The better yield of grain with different level of fertilizer was obtained from (SC-221) while the lower grain yield was received from hybrid (DC-368). According to different parameters such as kernel per plant, plant height, number of grain per cob, grains row per cob, stem diameter, leaf area index increased by hybrid (SC-402) while minimum were observed in hybrid (DC-300). The maximum grain yield was observed from hybrid (SC-300) with the application of boron and nitrogen applied at the rate of 250 kg ha-1.

[47] Evaluated the impact of three corn hybrids (P-31-R-66, M-912, B-201) and three level of fertilizer such as nitrogen on growth and yield of corn crops. The maximum harvest index was produced by H1 along with nitrogen treatment N3. The lower harvest index was produced by H2 along with application of nitrogen treatment N2. The hybrid P-31-R-66 produced maximum grain yield performed over hybrid H2. The maximum grain yield was achieved from hybrid one while the lower grain yields were obtained from hybrid two. The hybrid one showed the significant results on grain yields while the hybrid two shows non- significant result on grain yield kg ha-1. The hybrid one were further used for successful improvement for maize growth and sufficient production. [48] Examined four maize hybrids with application of micro-nutrient such as boron, manganese and copper. The obtained result showed significant difference of hybrid of maize in plant height, shoot length, root length and stem length with application of boron, manganese and copper nutrients. The excess amounts can inhibit plants growth and development in many ways. However the application of optimum concentration was significant enhanced DK-2530 plants development, grain yield, and biological yield of maize crops.

[49] Examine the effect of hybrids (SC-129 and SC-9)

maize to nitrogen level on consumption and production of maize crops. The result reveals that the maize hybrids and nitrogen showed significant results on growth, yield and yield component. The maximum leaf area index, plant height, thousand grain yield and harvest index obtained with the application of nitrogen at the rate of 300 kg ha-1 among the hybrid of maize such as (SC-129). The results show that the maximum thousand kernel produced by hybrid (SC-129). While the minimum thousand kernels by (SC-9) with nitrogen at the rate of 300 kg ha-1. The result reveal that the maize hybrids such as SC-129 and SC-9 and nitrogen at the rate of 300 kg ha-1 can be used for better improvement and for enhancement of maize hybrid production. [50] Examined the response of maize hybrids involving Baber, Pioneer-3025, Cargill-606 and cargill-822 planted on spacing at 20, 30, 40 and 50 cm. The results showed that the maximum number of grains per cob, cob diameter, and emergence per meter square, plant height were affected significantly by hybrids maize. The hybrids maize such as Pioneer increases significantly number of grains per cob, 1000 gain yield, and Biological yield kg ha-1 as compared to other maize hybrids. The highest numbers of grain per cob were observed from pioneer hybrid enhanced 1000 grain yield compared to Cargill maize hybrids [51].

Conclusion

It is concluded that boron is very important nutrient from growth, phenology and yield. However, optimum dose and cultivar is needed to achieve the maximum yield of maize.

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