Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 3797-3800
Received: 13-03-2019
Accepted: 15-04-2019

Badwal DPS
M.Sc. Ag. (Agronomy) Student Department of Agricultural Sciences, Sant Baba Bhag Singh University, Khiala, Jalandhar, Punjab, India

Simran
M.Sc.Ag. (Agronomy) Student Department of Agricultural Sciences, Sant Baba Bhag Singh University, Khiala, Jalandhar, Punjab, India

Kaur S
Department of Agricultural Sciences, Sant Baba Bhag Singh University, Khiala, Jalandhar, Punjab, India

Singh V
M.Sc. Ag. (Agronomy) Student Department of Agricultural Sciences, Sant Baba Bhag Singh University, Khiala, Jalandhar, Punjab, India

Kaushal S
Assistant Professor, Department of Agricultural Sciences Sant Baba Bhag Singh University, Khiala, Jalandhar, Punjab India

Correspondence
Badwal DPS
M.Sc.Ag. (Agronomy) Student Department of Agricultural Sciences, Sant Baba Bhag Singh University, Khiala, Jalandhar, Punjab, India

Role of nitrogenous fertilizer in maize: A review

Badwal DPS, Simran, Kaur S, Singh V and Kaushal S

Abstract
The rate, time and method of nitrogen fertilizer application mainly influence the growth, development, yield of the crop. Growth attributes like number of leaves per plant, dry matter accumulation, leaf area index vary with dose of applied nitrogen. Quality parameters such as protein content, total sugar content, minerals were affected by different nitrogen levels. Total minerals in maize grains were increased with high nitrogen rate. The yield components of maize (cob length, no. of kernels per cob, cob weight, kernel weight on cob, grain weight) were also affected with nitrogen dosage. As nitrogen is an integral part of chlorophyll molecule as well as grain nitrogen uptake is also effected by nitrogen element. This review emphasized the role of nitrogen on growth, development and production of maize and also focuses on method and rate of fertilizer application for higher yield. In addition to this, performance of nitrogen on different growth and yield components.

Keywords: Maize, yield components, cob length, cob weight, grain weight

Introduction
Maize (*Zea mays* L.) is one of the most important cereal crops in the world. It ranks third in the world production of cereals next to wheat and rice. It is also known as the queen of cereals as it has the highest yield potential among the cereals. Nitrogen is the primary factor responsible for higher yield and also for improving yield components of maize (cob length, no. of grains per cob) were also affected with nitrogen dosage (Mahammed and Shirdon 2013) [1]. Nitrogen often affects the amino acid composition of protein, and thus the quality of nutrients. Nitrogen is a component of protoplasm, nucleic acid, chlorophyll and also plays significant role in vegetative as well as in reproductive phases of crop. (Ayub *et al.* 2003) [2] observed that higher nitrogen application increased plant height, dry matter, crude protein, stem diameter, green fodder yield, crude fibre, total ash percent. Nitrogen also helps in vital processes of plant, as synthesis of protein, ionic absorption, respiration, cell differentiation and multiplication (Marschner *et al.* 2006) [3]. Increased nitrogen supply often leads to kernel integrity and strength, resulting in better milking properties of the grain (Blumenthal *et al.* 2008) [4].
Nitrogen also plays important role in the development of ear and kernel. It affects various physiological and biochemical processes in plant cells. Studies on nitrogen translocation in the plant showed that nitrogen appears to move from other plant tissues to the ear before silking, apparently in case of nitrogen- intense process of kernel embryo formation (Ciampitti and Vyn 2010) [5]. Nitrogen takes part in different metabolic pathways of great importance to plants. The protoplast of plant cells contains mainly nitrogen so. Nitrogen also plays essential role in the growth and proper development of plant.

Time and methods of nitrogen application
Availability of sufficient N during the growth phases of maize results as in agronomic benefits. (Scharf *et al.* 2002) [6] observed that the significant increase in maize yield when N was applied in split form. The full dose of N in one split is not suggested because it leads to the loss of plant as well as it cannot utilize all the N at once, so to enhance the N use efficiency and yield it is advised to use N application in split doses. In split doses half of dosage is preferred at basal and half at knee high or silking stage is preferred. In terms of application timings, nitrogen half dose at sowing and another half after 25 DAS gave maximum grain yield was reported by Anwar *et al.* (2017) [7]. The timing of nitrogen application affects the yield of maize (Bhattarai *et al.* 2004) [8]. Nitrogen application timing also shows effect on plant height as well as increase in leaf area. Mariga *et al.* (2000) [9] reported that the yield of maize was considerably increased when N was applied up to tassel initiation stage. (Gehl *et al.* 2005) [10] observed that maize N uptake improved and grain yield increased with split N fertilization compared to one single application at planting under irrigation system.

Therefore an excellent time of application is during tasseling and silking stages. Nurudeen *et al.* (2015) [11] observed that maximum grain and biomass yield observed after application of Nitrogen @ 80 kg ha^{-1} in two split doses; half part as a basal dose and half during knee – high stage as side dressed respectively.

In comparison to the traditional broadcast fertilization, fertilization in rows combined partly with top dressing increased the values of percentage of fertilizer nitrogen in total nitrogen uptake as well as agricultural and physiological effectiveness of nitrogen use (Szulc *et al.* 2016) [12]. It was also observed that row fertilizer application of 100 kg N ha^{-1} or combined with top dressing is more beneficial as comparison of traditional broadcasting fertilization at same N dosage, increased protein yield, uptake, utilization of N. In conclusion top dressing and split dosage of application of N promotes high N uptake as well as better absorbing of N fertilizer.

Dose of nitrogen

Application of 180 kg N ha^{-1} produced maximum and significantly higher yield of (66.2 q ha^{-1}) as compared to 0, 90, 120 kg N ha^{-1} was observed by Kaur (2016) [13]. The higher grain yield at higher doses of nitrogen might have increased he chlorophyll content index since N is important constituent of chlorophyll. Parija (2011) [14] found that application of of 150 kg N ha^{-1} produced significantly higher yield as compared to 0, 75, 100, 125 kg N ha^{-1}. The increase in grain yield of maize with increase of N levels was also reported by the Pratyush and Hemalatha (2013) [15], Ullah *et al.* (2015) [16]. Abebe and Feysia (2017) [17] observed that the rate of the application of N fertilizer effects the yield of crop.

Grain nitrogen uptake

Nutrient uptake by grain of maize was found to be maximum with increase in level from 120 kg N ha^{-1} to 180 kg N ha^{-1}. This was due to increase in dry matter accumulation, grain straw and biological yield. Among different N levels maximum N uptake was found in 180 kg N ha^{-1} and minimum in 120 kg N ha^{-1} (Tiwari *et al.* 2018) [18]. Plant population range from 69,000 to 81,000 plants ha^{-1}, showed a significantly higher uptake of nitrogen then the 57,000 plant population ha^{-1} observed during 12 leaf and tasseling stages (Al–Kaisi and Yin 2003) [19].

Nitrogen uptake by the maize plant increases its concentration in both the plant or in the grain due to the higher total dry matter content. The nitrogen applied from 0 to 150 kg ha^{-1} showed a proportional enhancement in grain yield and nitrogen concentration in the various parts of the plant (Ram and Thakur 1966) [20]. In the same way Pokhrel *et al.* (2009) [21] found that more nitrogen applied produces a larger nitrogen intake per grain due to higher dry matter yield. The total nitrogen uptake by maize was increased with increase of N level upto 240 kg N ha^{-1} but it was statistically at par with the application of 180 kg N ha^{-1} (Ramu and Reddy, 2007) [22].

Effect of nitrogen on growth

Maize crop has massive nitrogen utilizing capacity so it requires a high quantity of crops. For higher yield of maize, a higher volume of N is required. Low yield of maize is observed when less nitrogen is applied during silking or tasseling stage but factors such as nutrients in soil, variety also influences the yield of maize. The general nutrient recommendation for maize crop is 120:60:40 kg ha^{-1}, N, P and K respectively (Shivay and Singh 2002) [23]. Excess of N fertilizer results as lodging due to weak stems with reduced cell walls and resistance to pests and diseases also reduced due to excessive dosage of N then the recommended dosage. The capacity of the crop to absorb the nutrients and use the nutrients also depends on presence of N in plants. Therefore, maize yield is reduced due to lack or excess of nitrogen, so the use of nitrogen fertilizer plays significant role in better yields. Application of nitrogen at 120 kg ha^{-1} significantly increased the plant height, leaf area per plant, leaf number, crude fibre, dry matter. Shivay and Singh (2000) [23] showed significant effect on yield with successive increase in N from 0 to 120 kg N ha^{-1}. Earlier silking is also occurred due to higher percent of nitrogen applied. Shreshtha (2015) [24] found early tasseling and silking stages in maize occurred as result of higher nitrogen application at 200 kg N ha^{-1}. Kaur (2016) [16] found that increment of Nitrogen levels of 180 kg N ha^{-1} produced significantly taller plants 218.3 cm as compared to 150 kg N ha^{-1}produced plants of 215 cm. It is might be due to increase in cell division and cell elongation which encourages shoot growth due to higher nitrogen dosage. Nitrogen is also an integral part of proteins, which helps in maintaining auxin level and results in growth of plant height (Singh *et al.* 2000) [25].

Effect of nitrogen on yield components on maize

Kaur (2016) [13] found that application of higher dose of nitrogen (180 kg N ha^{-1}) produced significantly the highest number of cobs per plant (1.01), cob length (17.9), cob girth (14.4), number of rows per cob (13.9), number of grains per cob (390.2), 1000 grain weight (299.5), shelling % (81.9). Results get support from findings of Parija (2011) [14] who reported cob length increased significantly with each increase in nitrogen level upto 150 kg N ha^{-1}. Application of 180 kg N ha^{-1} produced maximum 1000 grain weight (299.5g) which was observed by (Kaur and Vashisth 2015) [26]. The results are in conformity with the findings of Kumar (2009) [27] and Jassal (2013) [28]. Likewise Kaur (2016) [13] also observed that N applied from range of 90 to 180 kg ha^{-1} applied showed results as stover yield increases from 116.4 q ha^{-1} to 132.5 q ha^{-1} respectively and grain yield from 54.5 q ha^{-1} to 66.2 q ha^{-1} with dosage range from 90 to 180 kg ha^{-1} respectively. Gungula *et al.* (2007) [29] and Dwadi and Sah (2012) [30] found a higher application rate of Nitrogen effectively increased kernel number per ear and kernel rows number per cob.

Effect of nitrogen on growth attributes of maize

The application of Nitrogen has an important effect on the plant at different stages. The increase in plant height as 168.7 cm with 150 kg ha^{-1} and 147.9 cm with no N application shows increase of plant height by increment of N fertiliser (Kaur and Vashisth 2015) [26]. Similar results have been reported by (Singh 2010) [31]. Number of leaves per plant was recorded as 13.9 with application at the rate of 150 kg ha^{-1} and 12.3 with no N application after 90 DAS (Kaur *et al.* 2015). The increase in number of leaves per plant with each increment of nitrogen level might be attributed to increase in plant height and better crop growth. Similar results have been reported by (Singh 2010) [31] who reported that the application of 175 kg N ha^{-1} produced maximum number of leaves which were significantly higher than 100 kg N ha^{-1} and 125 kg N ha^{-1}. The Dry Matter Accumulation (DMA) was recorded as 211.0 g plant^{-1} with 180 kg N ha^{-1} and 172.7 g plant^{-1} with no N application (Kaur 2016) [13]. This might be due to the fact that highest nitrogen level produced maximum plant height and number of leaves per plant as compared to its lower levels

thus resulting in higher DMA. Similar findings were also reported by the Parija (2011) [14]. The increase in LAI was due to higher number of leaves per plant which may be to lesser senescence and leaf retention for longer period with higher nitrogen application. Mean values of data revealed that application of nitrogen at rate of 210 kg N ha^{-1} produced maximum LAI (2.76) which is statistically at par with 180 kg N ha^{-1} and 150 kg N ha^{-1} with the LAI of 2.54 and 2.52 respectively (Imran *et al*. 2015) [32]. The positive effect of nitrogen on LAI was also reported by, Brar (2013) [33]. The data pertaining to leaf chlorophyll content in maize is recoded as Soil Plant Analysis Diagnosis (SPAD). Maximum SPAD value (35.6) was observed with 150 kg N ha^{-1} which was significantly higher than all levels of nitrogen (Kaur and Vashisth 2015) [26]. Nitrogen is an integral part of chlorophyll molecule, therefore an increase in chlorophyll with increase in nitrogen level was observed.

Conclusion

- The role of nitrogen in maize depends upon various factors such as adequate management of nitrogen doses to be applied, time and method of application of nitrogen fertilizer.
- Nitrogen is important for the physiological as well as biochemical processes that mainly effects growth and development. The top dressing method of application of N fertilizer increased the values of percentage of total nitrogen uptake as well as physiological effectiveness of nitrogen use.
- Nitrogen is the primary factor which is responsible for higher yield and also for improving yields components of maize cob length, no. of grains per cob, cob girth etc. The various studies emphesized about the recommended dosage of N application used as a basal dosage at planting time, split doses at critical growth stages like tasseling or silking stage for increasing yield and production of maize.

References

1. Mahamed MB, Shirdon AD. Effect of different planting methods and nitrogen fertilizer rates on growth and yield of maize under rain-fed condition. Indian Journal of Agricultural Sciences. 2003; 1:1-7.
2. Ayub M, Ahmad R, Nadeem MA, Khan RMA. Effect of different levels of nitrogen and seed rates on growth, yield and quality of maize fodder. Pakistan Journal of Agricultural Sciences. 2003; 40:140-43.
3. Marschner H. Mineral nutrition of higher plants. London: Academic Press, 1995, 1995, 889.
4. Blumenthal J, Baltensperger D, Cassman KG, Mason S, Pavlista A. Importance and Effect of Nitrogen on Crop Quality and Health. Agronomy & Horticulture. Faculty Publications. University of Nebraska 2008; Available in: https://digitalcommons.unl.edu/agronomyfacpub/200.
5. Ciampitti IA Vyn TJ. A comprehensive study of plant density consequences on nitrogen uptake dynamics of maize plants from vegetative to reproductive stages. Field Crops Research, 2010; 121(1):2-18.
6. Scharf PC, William JW, John AL. Corn yield response to nitrogen fertilizer timing and deficiency level, Indian Journal of Agronomy 2002; 94:435-41.
7. Anwar S Ullah W Islam M Shafi M Iqbal A and Alambez M. Effect of nitrogen rates and application times on growth and yield of maize (*Zea mays* L.). Pure and Applied Biology, 2017, 60-096.
8. Bhattarai MS, Shrestha SP, Panta BB. Soil fertility management in maize and maize based cropping system in the western hills of Nepal. In: Proceedings of the 24th National Summer Workshop on Maize Research and Production in Nepal. Organized by NARC, NMRP, 2004; 198-206.
9. Mariga IK, Jonga M, Chivinge OA. The effect of timing of application of basal and topdressing fertilizers on maize yield at two rates of basal fertilizer. Crop Research. 2000; 20:372-80.
10. Gehl RJ, Schmidt JP, Maddux LD, Gordon WB. Corn yield response to nitrogen rate grown under Bursa conditions. Turkey Journal of Agriculture. 2005; 24:341-347.
11. Nurudeen AR, Tetteh FM. Modelling site-specific fertilizer recommendations for maize production in the Sudan savannah agro-ecology of Ghana. African Journal of Agricultural Research. 2015; 10(11):1136-1141.
12. Szulc P, Waligóra H, Michalski T, Rybus-Zajac M, Olejarski P. Efficiency of nitrogen fertilization based on the fertilizer application method and type of maize cultivar (*Zea mays* L.). Plant Soil and Environment. 2016; 62(3):135-142.
13. Kaur A. Effect of different planting methods and nitrogen levels on the growth, yield and quality of *Kharif* maize. M.Sc. Thesis, Department of Agronomy, Punjab Agricultural University, Ludhiana, 2016.
14. Parija B. Performance of Kharif maize under different levels of farmyard manure and nitrogen. M.Sc. Thesis, Department of Agronomy, Punjab Agricultural University, Ludhiana, 2011.
15. Prathyusha C, Hemalatha S. Yield and economics of specialty corn at various levels of nitrogen application under pongamia + maize agri- silvi system. International Journal of Advance Research. 2013; 1:476-81.
16. Ullah MI, Khakwani AA, Sadiq M, Awan I, Ghazanfarullah M. Effect of nitrogen ssssfertilization rates on growth, quality and economic return of fodder maize (*Zea mays* L.) Sarhad Journal of Agriculture. 2015; 31: 45-52.
17. Abebe Z, Feyisa H. Effect of nitrogen rates and time of application on yield of maize: rainfall variability influenced time of N application. International Journal of Agronomy, 2017.
18. Tiwari D, Hooda VS, Thakral SK, Yadav A, Sharma MK. Effect of planting methods, maize hybrids and nitrogen levels on nutrient uptake of high quality protein maize (*Zea mays* L.). International Journal Current Microbiology and Applied Science. 2018; 7(5):246-253.
19. Al-Kaisi MM, Yin. Effect of nitrogen rate, irrigation rate, and plant population on corn yield and water use efficiency. Indian of Journal Agronomy. 2003; 95(6):1475-1482.
20. Ram A, Thakur RN. Effect of fertilization on growth, yield and quality of maize. Indian Journal of Agronomy. 1966: 11(4):315-323.
21. Pokhrel BB, Sah SK, Amgain LP, Ojha BR. Response of promising maize cultivars to different nitrogen levels in winter. In: Proceeding of the Tenth Asian Regional Maize Workshop. 2009; 479-483.
22. Ramu YR, Reddy. Yield, nutrient uptake and economics of hybrid maize as influenced by plant stand, levels and time of nitrogen application. Crop Research. 2007; 33:41-45.

23. Shivay YS, Singh RP. Growth, yield attributes, yield and nitrogen uptake of maize (*Zea mays* L.) as influenced by cropping systems and nitrogen levels. Annual Agricultural Research. 2000; 21:494-98.
24. Shrestha J. Growth and Productivity of Winter Maize (*Zea mays* L.) Under Different Levels of Nitrogen and Plant Population. [on line] Dissertation.com, Boca Raton, USA. Available in: http://dissertation. com/books/1612334407. 2015
25. Singh A, Vyas AK, Singh AK. Effect of nitrogen and zinc application on growth, yield and net returns of maize (*Zea mays* L.). Annual Agricultural Research. 2000; 21:296-97.
26. Kaur J, Vashisht KK. Influence of Nitrogen levels, irrigation regimes and planting methods on growth attributes and yield of spring maize. Agricultual Research Journal. 2015; 52(1):13-18.
27. Kumar A. Production potential and nitrogen- use efficiency of sweet corn (*Zea mays* L.) as influenced by different planting densities and nitrogen levels. Indian Journal of Agricultural Science. 2009; 79:231-55.
28. Jassal RK. Effect of planting methods and nitrogen levels on the seed production of fodder maize. M.Sc. Thesis, Department of Agronomy, Punjab Agricultural University, Ludhiana, 2013.
29. Gungula DT, Togun AO, Kling JG. The effects of nitrogen rates on phenology and yield components of early maturing maize cultivars. Global Journal of Pure and Applied Sciences. 2007; 13(3):319-324.
30. Dawadi DR, Sah SK. Growth and yield of hybrid maize (*Zea mays* L.) in relation to planting density and nitrogen levels during winter season in Nepal. Tropical Agricultural Research. 2012; 23(3)218-227.
31. Singh G. Irrigation and nitrogen needs of August sown hybrid maize. M.Sc Thesis, Department of Agronomy, Punjab Agricultural Universty, Ludhiana, 2010.
32. Imran S, Arif M, Khan A, Khan MA, Shah W. Effect of Nitrogen Levels and Plant Population on Yield and Yield Components of Maize. Advances in Crop Science and Technology 2015; 3:170. doi:10.4172/2329-8863.1000170.
33. Brar HS. Performance of spring maize under different drip irrigation regimes, nitrogen levels and planting methods. Ph.D. Dessertation, Department of Agronomy, Punjab Agricultural University, Ludhiana, 2013.