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Nitrogen effects on sunflower growth: a review

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Abstract

Sunflower crop is very important in the world according to its quantity and quality among the new oil seed crops. The different strategies have been adopted to improve the yield of sunflower crop. One is to increase the achene yield is essential need of nitrogen fertilizer, and has a greatest impact on leaf size, number of leaves, head diameter, number of achene per head, 1000-achene weight and increase the seed yield. On other hand, by increasing the level of nitrogenous fertilizer, rapid enhance the leaf area development and life of leaves can be observed. Increase leaf area duration after flowering and enhance on the whole crop assimilation, consequently contributing to increase seed production. By sufficient supply of N application plays an important role to increase the head diameter, 1000- achene weight, biological seed yield, seed yield per head and per plant were increase through harvest index and decrease seed oil concentration. With increasing the level of nitrogenous fertilizer leaf gas exchange and shoot dry weight parameters improved. However, increase the amount of nitrogen fertilizer by enhancing vegetative growth of aerial parts and physical maturity. If high concentration of nitrogen fertilizer did not impact the leaf of weight but result in more dry weight production per plant. With increase in nitrogen supply, RUE may also be increase but in lower than LAI and IPAR(IntegratedPhoto synthetically Active Radiation).The nitrogen fertilizer is essential nutrient for plant growth, the previous studies shows that higher or less quantity has negative impact on plant growth. Appropriate quantity must be need for better of plant growth. In this review described a best time and accurate amount of fertilizer.

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Introduction

The sunflower (*Helianthus annus* L.) is essential crop due to its quality and quantity have good rank among the new oil seed crops, and easily adopt a highly a warm season and drought tolerant crop; adapt to high temperature and moisture limited conditions in all over the world. In Pakistan, sunflower grown in both rain fed and irrigated area because it is a drought resistant crop. It is a deep rooted crop and pulls out water from below the root zone of soil. It show positive response on limitation of precipitation, soil water and irrigation to growth and yield (Unger PW, 1990). Sunflower yield in Pakistan is very low as compared to other countries due to less and improper use of fertilization. All the nutrients are important but nitrogen is most essential, because it increase in root and leaf length, leaf area duration, photosynthesis and increase seed yield (Faisal *et al*., 2005). There are many responsible factors for increasing yield per hacter but management of fertilizers is more important for increasing growth, development and achene yield of sunflower crop (Narwal and Malik, 1985). Nitrogen is consider essential nutrient for sunflower crop, which increased vegetative growth and seed yield, but excessive fertilization increased plant height and lodging (Bailey LD, 1990; Weiss EA, 2000 Zubillaga *et al*., 2000). The farmer have no accurate knowledge how much quantity of nitrogen fertilizer and best time to apply for enhance the yield (Malik 2006).It is also important to select such kind of hybrids those are adopting to local climate which are early maturating, having high oil contents and producing high seed yield under summer temperature and drought conditions (Bakht 2006).

Effect of nitrogen application on sunflower

Increased the cost of chemical nitrogen fertilizer and concerns about the adverse environmental factors impacts of nitrogen losses there is great interest of fine-tuning of management. All nutrients were important for sunflower crop, but more essential nutrient is nitrogen for plant growth and development. Nitrogen contents per plant and shoot dry matter increased with increasing the nitrogen rate, but decreased with increasing plant population density. Low application of nitrogen enhanced the duration but decreased leaf expansion and distribution of dry matter are reported by (Steer *et al*., 1986). Growth and development of plants was increased by increasing the nitrogen application and decreased with decreasing the nitrogen rate. The total amount of dry matter production by sunflower was potential to intercepted photo synthetically active radiation, noted that by utilization of 1MJ of PAR produced to 3.5g of above ground matter was produced in sunflower (Kiniry *et al*., 1989). Bindra and kharawara (1989) observed that Sunflower cultivar EC-68414 was grown palampur (India) 1988-1989 in spring season, with nitrogen fertilizer at the rate of 0, 30, 60 and 90 kg N ha^{-1}. The results were note from scientific study increasing the nitrogen application rate cause higher oil and seed up to 60 kg nitrogen per hectare (Sarmah 1992) concluded that when 80 kg nitrogen + 40 kg phosphorus and 60 kg N + 30 kg phosphors ha^{-1} were applied to sunflower, the yield was obtained doubled at the treatment of 80 kg nitrogen and 40 kg phosphorus per hectare. The experiment was conducted with three different levels of chemically nitrogen fertilizer levels (45, 60, 75 kg ha^{-1}) with three row spacing in sunflower crop (45cm, 60cm and 75cm) on different hybrids BSH-1 at 60 cm row spacing with nitrogen 75 kg ha^{-1} application, with increased the plant height, of stem and capitilum diameter and number of filled seed per head (Ujjinaiah *et al*., 1995). Ayub *et al*., (1999) conducted an experiment to checked plant growth and development parameters with applying four treatments of different nitrogen fertilizer levels (0, 50, 100 and 150 kg ha^{-1}) was applied on two sunflower cultivars Aritar-93 and Suncom-110, which produced higher plant height, number of leafs per plant and weight of 1000-seed and achene yield. Plant height, leaf area per plant, stem diameter, number of seed per disc and achene protein contents were maximum at applying of 150 kg N ha^{-1}, similar good achene yield was achieved with nitrogen 100 and 150 kg N ha^{-1}. (Malik *et al*., 1999). evaluated the various nitrogen application rates and sources of nitrogen on sunflower hybrid Hysun- 33 are show positive response for yield, growth components, stem height,

diameter of head, no of seeds per capitilium. The three different levels of nitrogen were selected (100, 150 and 200 kg ha^{-1})and applied on sunflower to produce grain yield 22.3, 28.7 and 35.4 g ha^{-1} respectively. Results were noted at 200 kg N ha^{-1}increase the maximum no of filled seed, oil and protein contents Ghani *et al*., 2000). Gutierrez *et al*., (2000) carried out the field study with three nitrogen application rate (0, 100 and 200 kg nitrogen per hacter) with plant densities (50,000, 75,000 and 100.000 per hacter) on different parameters of sunflower. Increasing the nitrogen levels then boost up biomass production, seed yield, 1000 achene weight, number of achene per head, head diameter, water use efficiency and nutrient use efficiency. (Sadiq *et al*., (2000)reported that by increasing the nitrogen level were needed more number of days from flowering to maturity. Plant height, head diameter and maximum 1000- seed weight were obtained by 80 kg nitrogen per hector were applied on sunflower. The study was carried out to check the performance of various combination of nitrogen and phosphorus fertilizer was analyzed in sunflower. The one kg of fertilizer input increase the seed yield from 8.4 to 8.9 kg in sunflower Ailincai *et al*., 2009). Sunflower variety Shmas was grown in pot to check the effect of water stress and nitrogen fertilizer due to these effects, providing stress condition this experiment after ten days 20, 30, 40 and 50 days after sowing. The results were observed that due to water stress and nitrogen fertilizer have significantly affected on root length (Meo, 2000). The five different nitrogen fertilizer application rates (0, 40, 80, 120 and 160 kg nitrogen per hacter) with also five phosphorus rates (0, 20, 40 and 60 kg phosphorus per hacter) as well as sulphur rates (0, 25 and 50 kg sulphur per hector) were applied on sunflower. The highest seed yield from this experiment was recorded in those plot where the treated level of 120-60-50 kg NPS ha^{-1}(Maragatham and Chellamutha 2000) Reddy *et al*., (2000) Demonstrated that sunflower was grown with different treatments rates of nitrogen fertilizer (0, 50, 100 or 150 kg ha^{-1}) and phosphorus (0, 40, 80, 120 kg P ha^{-1}) were applied on sunflower. The results were founded that increasing the phosphorus application then plant height and yield was increase but maximum plant height and yield was recorded with the application 100 kg N ha^{-1}Singh *et al*., (2000) Applied different nitrogen regimes (0, 23, 46, 69 and 92 kg ha^{-1}) on sunflower, which enhanced the head diameter, number of seed and oil contents by increasing the nitrogen application. Iqbal *et al*., 2001) Demonstrated the genotype (MSFH 88 and EC 6841C) response for irrigation and nitrogen level, when sunflower cultivar was treated with level of 120 kg N ha^{-1} which ultimately increased seed yield, water use efficiency. N :P : K at the rate of 120: 75: 50 kg ha^{-1} were applied to sunflower and obtained maximum height of plant, number of leaf per plant, leaf area and dick diameter. Vijayakumar *et al*., (2001) stated that split application of nitrogen significantly enhanced the performance of sunflower. The 40 kg N ha^{-1} were applied two different doses. First dose was applied on sowing and second 1/6 applied at 6 weeks after sowing results were observed more plant height, stem girth, head diameter, percentage of filled seeds, 1000 achene weight and stalk yield.

In a field experiment the response of sunflower to nitrogen fertilizer with irrigation to check the quantity of oil and yield of sunflower. This comprised of four levels of irrigation based on irrigation water: cumulative pan evaporation (IW: CPE) ratio of 0.4, 0.6, 0.8 (1,2 and 3 irrigations respectively) and 4 levels of nitrogen (0, 20, 40 and 60 kg ha^{-1}). The results were showed that leaf area index (LAI) and other ancillary characters were maximum with three irrigation and 40 kg nitrogen per hector (Prasad *et al*., 2001). Scheiner *et al*., (2002) to checked the response of nitrogenous fertilizer should be applying according to crop requirement to avoid over fertilization. When 40 kg N ha^{-1} were applied to sunflower then leaf area index, oil (%) and water use efficiency were high. Santalla *et al*., (2002)conducted an experiment on two sunflower hybrids to check the effect of intercepted active solar radiation on seed weight and percentage of oil contents of low and high potential oil % was studied.

Rehman (2002) demonstrated that combination of fertilizer NPK at the rate of 100-70-0 kg ha^{-1} were applied to sunflower hybrid FH-81, results were recorded obtained the maximum yield. Thava prakash Malligawad (2002) evaluated that fertilizer ratio are 120-120-60 kg NPK ha^{-1} were applied to sunflower and concluded that higher seed yield, more grass return, more net return and higher cost ratio were obtained. The four nitrogen application rates (0, 30, 60 and 90 kg ha^{-1}) were applied on hybrid sunflower results were observed highest seed yield obtained at 60 kg nitrogen per hector is applied (Kumara *et al.*, 2003).In a field study the response of sunflower to (0, 60, 120 and 180 kg ha^{-1}) and applying with four different levels of P_2O_5 fertilizer (0, 30, 60 and 90 kg ha^{-1}) and as well with four levels of potassium fertilizer (0, 60, 120 and 180 kg ha^{-1}), The results are founded, positive and good yield obtained in that plot where treatment rate was 120, 90 and 60 kg ha^{-1} NPK (Nawaz *et al.*, 2003). Ruffo *et al.*, (2003) observed that five levels of nitrogen were broadcast on the crop of sunflower (0, 25, 50, 100 and 200 kg ha^{-1}). When crop achieved three pairs of fully expended leaves, results are observed no of grain and oil yield are increase with increasing the nitrogen fertilizer. The four levels of nitrogen (0, 80, 120, 160 kg N ha^{-1}) with three levels of phosphorus (0, 60, 90 kg per hacter) were applied on sunflower at NWFP Agriculture university of Peshawar. When 160 kg N ha^{-1} were applied then increase the diameter of sunflower head (25.7 cm), number of achene per head (114.84) and 1000 seed weight (75.67), increase the phosphorus level then increase the plant height and 1000 achene weight. At 160 kg nitrogen per hector then plant height 198.2 is found but Heavy seeds (70.67) were found at 90 kg phosphorus per hacter. The conclusion was that 160 kg N ha^{-1} with 90 kg P ha^{-1} is best for sunflower hybrid (Arif *et al.*, 2003). Hakoomat *et al.*, (2004) evaluated that the crop sunflower hybrid was fertilized with five different nitrogen treatments @ (0, 50, 100, 150 and 200 kg N ha^{-1}). The sowing was done at 10th August show a best results where the nitrogen application rate was 200 kg ha^{-1} gave highest leaf area per plant, plant height and head diameter. While application with 150 kg N ha^{-1} gave higher1000 seed weight and the application is 100 kg N ha^{-1} obtain highest biological yield, seed yield and highest oil contents. Cechin and Fumis (2004) recorded that due to high nitrogen concentration cause more shoot dry matter production, leaf production and individual leaf dry matter were appeared after 29 days after sowing of sunflower. The photosynthesis CO_2 assimilation is increase by enhancing the nitrogen concentration but specific leaf weight was not affected by increasing the nitrogen concentration. When more nitrogen was applied to plants these had low intercellular concentration when compared with lower nitrogen rates. When nitrogen rate was 120 kg per hacter then yield response was positive and linear (Ozer *et al.*, 2004).

Khaliq (2004) stated that response of nitrogen was positive on growth and development, but the maximum achene yield of sunflower was obtained with the application of 200 kg N ha^{-1}.Akthar (2004) demonstrated that applying the various rate of nitrogen was significantly enhance the seed yield, leaf area index, crop growth as well as assimilation rate. Different nitrogen levels (0, 50, 100 kg ha^{-1}) were applied on crop of sunflower. They observed that significant difference was in yield, oil content percentage, total nitrogen uptake and nitrogen use efficiency. At 50 kg N ha^{-1}were applied show better utilization, uptake and use efficiency of nitrogen parameter with yield. (Monemurro and Giorgio 2005). Albrizio and Steduto (2005) stated that in a field experiment response of sunflower three irrigation different nitrogen application rates (0, 100 and 200 kg per hector) were applied on spring sown sunflower hybrid (NK-265) and obtained the results are total dry matter production varies with irrigation timing and nitrogen rates. The application of nitrogen 200 kg N ha^{-1} and different agronomic traits were applied on sunflower then highest TDM production were recorded, increase the nitrogen rate then decrease the harvesting index. [42] stated that five application of N rate (0,50, 100, 150 and 200 kg N ha^{-1}) with four different plant spacing (20, 25, 30 and 35cm) were applied on sunflower, results are

conducted that 200kg N ha^{-1} and 25cm plant spacing produced highest yield. Tonev (2006) design an experiment sow sunflower hybrid after wheat at different locations with optimum nitrogen fertilization had a positive effect on leaf area, increase the crop till the period of intensive growth (budding). When roots of sunflower reach 1m under the layer of soil then direct nitrogen fertilization become insignificant for the growth of sunflower, direct nitrogen fertilization had positive effect on biological productivity at budding stage.

Munir *et al.*, (2007) design an experiment to check the combination effect of inorganic fertilizer on sunflower are produced the highest yield in plot where application rate was 100-57-50 NPK kg ha^{-1} as compared to organic fertilizer. Brennan and Bolland (2007) observed that using of four rates of nitrogen (0, 46, 92, and 138 kg ha^{-1}) were tested on sunflower, results are obtained that increasing the nitrogen fertilizer then increase the yield, protein contents but decrease the oil contents.

Massignam *et al.*, (2009) reported that the results are observed from the field study the utilization of nitrogen was not same in all crops. The purpose of this study to identify the physiological process in maize and sunflower. Grain yield in maize (range: 210-1255 g m^{-2}) was more response to nitrogen supply then in sunflower (106-555 g m^{-2} in carbohydrate equivalents) over wide range of total nitrogen uptake (3->20 g N m^{-2}). The reductions in biomass production reduce by the nitrogen supply. The radiation interception and radiation use efficiency (RUE)(was reducing due to decrease the nitrogen supply. The nitrogen response was more in maize because total biomass production of maize was high then sunflower.

Nasim *et al.*, (2012) an experiment of three sunflower hybrids (Hysun-33, Hysun-38 and pioneer-64A93) with five different nitrogen fertilizer levels (N1 = 0 kg N ha^{-1}, N2 = 60 kg N ha^{-1}, N3 = 120 kg N ha^{-1}, N4 = 180 kg N ha^{-1}, N5 = 240 kg N ha^{-1}) under agro climatic condition of Gujranwala. The randomized complete block design was selected under split plot, cultivar in main plot and nitrogen level in subplots. The results were observed Hysun-38 produced maximum total dry matter production (15815 kg ha^{-1}) and achene yield (3389 kg ha^{-1}), while minimum total dry matter (14640 kg ha^{-1}) and seed yield (3125 kg ha^{-1}) was observed in Hysun-33. When three variety of sunflower were treated at same treatment level 180 kg N ha^{-1}, gave maximum total dry matter (17890 kg ha^{-1}) and achene yield (3809 kg ha^{-1}) compared to other nitrogen rates. An experiment was carried out the various nitrogen treatment levels (0, 150, 200 and 250) and with planting date of sunflower crop. Results showed that stem diameter, diameter of head, number of grain per head, achene yield and biological yield was affected by plating date. The effect of different levels of nitrogen was significant effect on plant height, stem diameter, biological yield and harvesting index (Soleymani *et al.*, 2013).

Nitrogen in relation to crop growth

Nitrogen is consider a major and essential nutrient to increase the crop growth rate, development and obtained the highest grain yield. It is helpful for many process from biophysical and biochemical to tissues and organ levels. Different ecological variables such as temperature that effects on crop growth and development of plants consider as main determinants for regulation of various phenomenon (Ritchie and Smith 1991). Increasing the level of nitrogenous fertilizer is also boost up the crop growth, development and photosynthesis rate (Fayyaz-ul-Hassan Cheema 2005). The many studies are reported about application of nitrogen effect on crop and improved of sunflower plants. The deficiency of nitrogen element is highly impact on vegetative (leaves) and reproductive (florets and seed) stage of sunflower. The earliest phases of growth especially at vegetative stage, deficiency of nitrogen fertilizer cause decrease the number of leaves and also retards the growth of leaves, resulting is that decrease the leaf area index, development and interception radiation (Hocking and Steer 1983).

The ample supply of nitrogen is essential for increase all the metabolic process accountable rapid growth, development and higher production of crop yield (Lawler DW. 2002; Khaliq *et al.*, 2008; Nasim 2010). Different research studies evaluated that insufficient dose of nitrogenous fertilizer is decrease the photosynthesis rate, leaf growth, individual leaf area which receive low light interception (Toth *et al.*, 2002). Leaf nitrogen contents of elevated and exhibits a well-built alliance between photosynthesis and leaf nitrogen contents of many C4 (Photo synthetically active) and C3 (Less Photo synthetically active) species when insufficient supply of nitrogen (Conner at al., 1993).In leaf chloroplast nitrogen contents are preset, 75% are utilized in ribose Biphonsphate carboxylase. The lesser supply of nitrogen is effect the rate of photosynthesis are often recognized to lesser green pigments and performance of Rubisco enzyme (Fredeen *et al.*, 1991). Results are evaluated from research study photosynthesis activity and chlorophyll contents are more under higher dose of nitrogen application (160 kg N ha^{-1}) when compared with no application of nitrogenous fertilizer (Khaliq, 2004).

Nitrogen in relation to yield components

Many studies was conducted to evaluated the effected of nitrogen on yield and yield components of sunflower crop (plant height, crop growth rate, leaf area index, head diameter, number of achene per head, 1000 achene weight, achene yield), the highest achene yield was observed where the treated plots with nitrogen fertilizer level 75 to 100 kg N ha^{-1} and then decrease where the level was 120 kg N ha^{-1} was noticed by many scientists around the world (Andhlae and Kalbhor, 1980, Sing, 2007). Whereas researcher described that most adventious results are found at application level of 80 to 85 kg N ha^{-1}(Sing JK. 2007, Smiderl *et al.*, 2005). The research study was conducted to describe the highest grain yield (992 t/ha) was obtained the nitrogen ratio of 200 kg N ha^{-1}. A research study was conducted to check the response of nitrogen on sunflower was liner and positive for obtained the highest grain yield. Head diameter is prime importance for determine the seed yield. , (Khaliq, 2004, Smiderl *et al.*, 2005). [37,59] concluded from research study weight of seed was increased up to 80 kg N ha^{-1} and then decline was noted at the level of 120 kg N ha^{-1}. Many other researchers (Poonia , 2003, Khaliq, 2004, Ahmad *et al.*, 2005) was noticed that weight of seed increase up to the application level of 160 120 kg N ha^{-1}.

Canopy development, light interception and radiation use efficiency

Nitrogen is consider essential nutrient for canopy development when reduce the level of this nutrient directly reduce the carbon assimilation, photosynthesis, canopy development, new leaf area development and start leaf senescence is studied by (Massignam *et al.*, 2003). Sinclsir and Muchow (1999)stated that accumulation of dry matter produced by crop is depends on ability of crop canopy to intercept incident photo syntactically active radiation as well as radiation use efficiency. Caviglia and Sadras (2001), Rodriguez wt al., (2000) demonstrated that deficiency of nitrogen in sunflower crop may be effect the interception of incoming photo-synthetically active radiation. If crops grown under nutrients deficiency leaf area index is more much effected by canopy architecture the net CO_2 affects the utilization efficiency of radiation and this process(CO_2 assimilation) depends upon availability of nitrogen fertilizer because it increase Rubisco contents in leaves. Sinclair and Horie (1989), Vega and Hall (2002) concluded that biomass production and harvest index of crop is highly effected by accumulation of intercepted radiation during grain filling period and these changes depends on at the stage of grain filling and green leaf area index. Proof From the research study if increase the level of nitrogen fertilizer and plant density is increase the grain yield, photosynthesis active radiation (PAR) (Dahmardeh, 2011). Bange *et al.*, 1997 was also provide evidence that dry matter accumulation was greatly affected by accumulated intercepted radiation rather than by radiation use efficiency (RUE).IPAR.

Conclusion

Increasing the nitrogen level have positive effect sunflower growth, but also have negative impact on its quality parameters. Therefore we revised many studies and concluded that appropriate dozes of nitrogen fertilizer are more important for its better growth and quality.

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