

**Review Article**

Review on: The Effect NPS Fertilizer Rate on Phenology, Growth and Yield Parameters of Food Barley (*Hordeum vulgare* L.)

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Abstract: Barley is one of the popular crops cultivated since ancient time in the world. Barley is one of the main cereal crops produced in the World and it is one of the most ancient crops among cereals and has played a significant role in the development of agriculture in the world. It is commonly used for food, animal feed and beverage value. The most important factors that reduce yield of barley is poor soil fertility, blanket recommendation of fertilizers, soil acidity (low soil pH), diseases and insects, poor crop management practices. The main objective of this paper is to review the effect of NPS fertilizer rates on food barley yield and yield components. Balanced fertilization is the key to sustainable crop production and maintenance of soil health. The yield of crop is depending upon the combined effect of many factors. Among these factors, the production and productivity is declining from time to time because of lack of combined application of input like recommended amount of fertilizers and management practices. Based on the review on the effect NPS fertilizer rate on phenology, growth and yield parameters of food barley. It has both economic and environmental consideration. The application of NPS fertilizer rates shows significant effect on growth, yield and yield components of food barley. It influence on the phenological, vegetative growth, yield and yield related parameters. Days to 50% heading, days to 90% maturity, spike length and number of tiller per plant were significantly affected by the NPS fertilizer rate. Then we should or need to focus on micro nutrients that are considered useless by farmers as well as researchers because those micro nutrients deficiency today shows clinical symptoms at human beings especially on children and infant women. Fertilizer suppliers or cooperative unions should pay attention to supply or blended type of the fertilizer instead of supplying single elements, the fact that the government and recognized researchers should give due attention to blended fertilizer to increase production of food Barley.

Keywords: Food Barley, NPS Fertilizer Rate, Yield and Yield Components

1. Introduction

1.1. Background and Justification

Barley (*Hordeum vulgare* L.) is one of the main cereal crops produced in the World and it is one of the most ancient crops among cereals and has played a significant role in the development of agriculture in the world [5]. The barley is ranked second among the winter cereals in the World and Turkey in respect of production and total yield [7]. Barley (*Hordeum vulgare* L.) is a fast growing, cool season annual

cereal crop that can be used as forage as well as cover crop to improve soil fertility [25]. The grain matures within 3-4 months and ripens in 20-40 days [46]. Barley ranks fourth among cereals in the world and is grown annually on 48 million hectares in a wide range of environments [14]. According to the reported that, barley is the fifth most important cereal crop after *teff*, wheat, maize, and sorghum in total production in the country [15]. Currently, in global scale barley, producing continent is: Americas (36.6ton ha⁻¹), Europe (35.5 ton/ha), Oceania (23ton ha⁻¹), Africa (17ton ha⁻¹) while the world average yield per hectare accounts about

(29.5).

In addition, reported indicated that, five leading countries in barley production in global scale ranking in descending order like, Canada accounting for 35 ton/ha⁻¹, Ukraine 29.6ton ha⁻¹, Turkey 26.9 ton ha⁻¹ Australia 22.4 tonha⁻¹ and Russian Federation accounts 21.6 ton ha⁻¹ [24].

Then application of blended types of fertilizers plays a major role in the universal need to increase food production to meet the demands of the growing world population. Fertilizer application resulted in marked crop yield increases and the extent to which fertilizers are used still differs considerably between various regions of the world [41]. The quantity of fertilizer nutrients required for optimum crop production depends on the inherent capacity of the soil to supply adequate levels of nutrients to growing plants the yield potential of the crop variety grown [57]. Nowadays, in different world especially in developing countries the soil is depleted its natural nutrients due to poor management practices of their field. Fertilizing is one of the most important agricultural practices in grain production. NP is the basic fertilizers used commonly, whereas S application is very little or non-existence in the production of barley. So to compensate the need of plants of nutrient application of combined fertilizers like NPS is essential to increase the yield.

1.2. Objective

To Review the effect of NPS fertilizer on the growth performance and yield component of food barley in Ethiopia.

2. Review of Literature

2.1. Effect of N, P and S on Growth and Yield Parameter of Food Barley

2.1.1. Effects of Nitrogen (N) on Phonological Parameters of Food Barley

Days to 50% heading of food barley as affected by nitrogen fertilizer levels which is the longest (91.33cm) days to heading were recorded from the highest (54 kg ha⁻¹) N fertilizer rate, while the shortest (73.5 cm) days of heading were obtained from control treatments [20]. Increased levels of N fertilizer from control (0 N) to highest (54 kg Nha⁻¹), days to heading increased consistently. This might be attributed to the behavior of increased N fertilizer increases vegetative growth of crops thereby it delaying heading time. [38] reported that a day to heading was significantly delayed when N fertilizer was applied at the highest rate for barley production compared to the lowest rate. According to [62] reported N application significantly affected days to heading of barley which is the longer day was recorded from at the highest rate of nitrogen level, this might be nitrogen enhances vegetative growth.

According to [62] report, the N levels of food barley has significant effect on days to physiological maturity which means the longest is (143cm) days to physiological maturity were recorded from the highest (54 kg/ha⁻¹) N fertilizer rate, while the shortest (125cm) day to physiological maturity was recorded from (0) control. This might be attributed to the

behavior of the fertilizer N which increases vegetative growth of crops thereby delaying physiological maturity. Moreover, under normal condition crops may take long days to maturity to exploit the available moisture and nutrients in the soil. Similarly, [58] reported as high rates of nitrogen prolong days to physiological maturity.

2.1.2. Effect of Nitrogen (N) on Growth and Yield Parameter of Food Barley

The values for nitrogen rates showed that plant height increased with each increment of nitrogen rates from the control to the highest rate. The tallest plant height (93.43cm) was recorded from (54 kg Nha⁻¹), while the shortest plant height (79cm) was recorded in the control (0 N) [20]. Such increment of plant height along with increase of N fertilizer rate might be related to the effect of nitrogen which promotes vegetative growth as other growth factors are in conjunction with it. This result is also in agreement with [42, 57] who reported that plant height of barely was increase with increasing rates of N fertilizer.

The number and mass of grains per spike are important structural elements for grain yield of cereals means that the N fertilizer rates increased from 0 to 18 and 36 kgN ha⁻¹ the grain yield was increased by 30.7 and 39.8%, respectively, indicating increasing response with increasing N fertilizer rates and also increases in grain yields of food barley crop with increasing levels of N fertilizer [6].

2.1.3. Effects of Phosphorus (P) on Phonological, Growth, Yield and Yield Components of Food Barley

Increase in Phosphorus application rate up to 30 kg/ha P led to reduction in the number of days required to heading of barley [20]. Maximum days of heading were recorded with 0 kg/ha P rate (control), while minimum days of heading were recorded with 40 kg/ha followed by 30 kg/ha P application with no difference. This is because of role of P for plants may facilitate plant growth as fast as and plants become early mature therefore it hasten maturity period.

In another way, number of tiller was increased with increasing of P levels [36]. This is also agreed with the result obtained that, number of productive tillers per plant was increased significantly as P fertilizer application level increases [62]. According to the researchers report, application of P slightly increased plant height as P rate increases [43, 58]. This result also in line with indicated that plant height linearly increased with increasing levels of P fertilization [28].

Biomass of barley significantly increased with increasing P levels. The highest biomass was recorded from at (40 kg) P application per hectare, while the lowest value of biomass was obtained at (0 kg) P application per hectare [54].

A similar result is recorded in which the highest total biomass at the highest P level used, whereas the lowest biological yield is recorded from control [62].

In addition grain yield of food barley significantly increased with increasing P levels. This component was highest at (40 kg) P application per hectare, while the lowest value of grain yield was obtained at (0 kg) P application per

hectare. Phosphorus fertilizer level increases significantly increase the grain yield of barley [41].

2.1.4. Effect of Sulphur (S) Fertilizer Rate on Yield and Yield Components of Food Barley

Food barley crop yield increased as S application rate increased in which the lowest barley yield was recorded from at the lowest rate of sulfur whereas the highest yield recorded from at the highest application rate [39]. Researcher reported that the highest plant height was obtained from the highest rate of S ha⁻¹ in barley [56]. The plant height increased as the doses increased and the highest plant height was obtained from the highest S ha⁻¹ application in barley crop [21].

2.2. Effects of NPS on Phonological, Vegetative and Yield Parameters of Food Barley

2.2.1. Effects of NPS on Phonological of Food Barley

Maximum days to 50% heading (78days) was recorded from 86–34–6 kg ha⁻¹ of NPS rate, While the lowest days to 50% heading (75 days) was recorded from 67–17–3 kg ha⁻¹ of NPS rate. Heading was almost 3 days late at the application of the highest rate of NPS rate than the lowest of NPS rate [20]. This might be blended type of fertilizer may be response to more vegetative growth because it supplies complete elements to development of plant. Similarly, [38] reported that a day to 50% heading was significantly delayed when NPS fertilizer was applied at the highest rate for barley production compared to the lowest rate. Contrary to the above reporters, NPS fertilizer showed no significant effect on the number of days to heading [41].

Delay in maturity time was greater at higher rates of NPS and was shorter at lower rate of NPS fertilizer [62]. These results might be that application of higher rates of NPS fertilizers can delay physiological maturity in food barley. However, [10] reported that Days to 90% physiological maturity was earlier (123 days) for highest NPS rate, while it was very late (127 days) at the lowest applied NPS rate. In line with [10] the findings of [55] reported that days to maturity of food barley was shorter at higher rates of NPS application.

2.2.2 Effects of NPS Fertilizer Rate on Vegetative Growth of Food Barley

Barley plant height was significantly increased by the recommended NPS rates (126kg ha⁻¹) as compared to the farmers practice and half of the recommended dose of NPS rates (62.5 kg N and 20 kg ha⁻¹ P [29]. Number of fertile tillers, thousand grain weight, biomass and grain yields of barley was significantly increased with application of both recommended NPS rates over control.

The tallest plant height (90.25cm) was recorded from NPS rate of 97.5-57-10.5kg ha⁻¹, followed by 91.8-45.6-8.4 kg ha⁻¹ and 88-38-7kg ha⁻¹ NPS; while the shortest plant height (77.58cm) was recorded at NPS rate of 86.1-34.2-6.3kg ha⁻¹. In line with the present [39] had reported that plant height increased as the NPS doses increased; and the highest plant height was obtained from the 250 kg ha⁻¹ NPS blended fertilizer (103.7cm) in food barley. Similar results were also reported by [57] that plant height of barely had increased with increased rates of NP from control to 69/30 kg ha⁻¹.

2.2.3. Effects of NPS on Yield and Yield Component of Food Barley

The total number tillers per plant was increased significantly across the increased rates of NPS fertilizer, that is the maximum number of tillers per plant was produced by plants treated with (120kg) NPS ha⁻¹, whereas the minimum number of tillers per plant was produced at the lower rates (0kg) NPS ha⁻¹ [21].

The improvement in total number of tillers with NPS application might be due to the role of P found in NPS in emerging radical and seminal roots during seedling establishment in barley.

The result also agree with the result obtained by [57] who reported that number of productive tillers per plant was affected significantly by higher NPS fertilizer application rate. Generally, number of productive tillers per plant recorded over all the treated plots was significantly higher than the unfertilized plot/control.

Sulfur uptake by grain and straw was affected due to the application of the different level of blended fertilizers according to report of [57]. The highest S uptake by grain (11.9kg ha⁻¹) and straw (25.2 kg ha⁻¹) was obtained from 120 kg ha⁻¹ NPS blended fertilizers, while the lowest S uptake by grain (1.0 kg ha⁻¹) and straw (2.7kg ha⁻¹) was obtained from control. This might be blended type of fertilizer application is give immediate response for micro nutrients especially for sulfur. According to the report of [45] who reported that, the highest spike length was recorded at highest application rates of NPS blended fertilizer on food barley. Which is the longest spike length was recorded (7.071 cm) at highest application rates of NPS blended fertilizer on food barley, whereas the shortest spikes (6.524cm and 6.531) were produced at the control and or lowest rate (0) and 30 NPS blended fertilizer respectively.

The application of NPS fertilizer rate was affected thousand kernel weight of barley. Increased rate of NPS thousand kernels weight of barley even though there is no consistency which means that,

Research concluded that, the highest thousand kernels weight (42.57 g) is recorded at combined application of 120 kg NPS ha⁻¹, while the minimum thousand kernel weight (33.17 g) is observed at combined application of (0kg) NPS ha⁻¹ [69]. This might be the effect of NPS fertilizer rate on thousand seed weight might be attributed to the positive effect of NPS on grain yields of plants. Similar result was reported by [23].

Table 1. Effect of NPS fertilizer rate on Spike length.

NPS fertilizer rate (kg ha ⁻¹)	Spike length (cm)
0	6.524
30	6.531
60	6.593
90	7.017
120	6.596

Source: [37]

Table 2. The Effect of NPS fertilizer rate growth, yield and yield related parameters of food barley.

Fertilizer rate (kg ha ⁻¹)	Number of tiller per plant (m ²)	Number of productive tiller per plant (cm)	Thousand kernels weight (g) gram	Straw Yield (qtha ⁻¹)	Yield (qt ha ⁻¹)
0	3.263	2.592	33.17	3720	1076
30	3.787	3.163	39.71	4899	2103
60	3.858	3.14	35.58	5363	3347
90	4.091	3.295	38.28	6425	3652
120	4.667	2.977	42.57	7465	4184

Source: [64]

Increasing NPS rate increase grain yield of barley where the application of the lowest NPS ha⁻¹ less grain yields. In line with [41], report of [19] also found that increasing NPS rate increased grain yield of barley. According to the report of [48], NPS fertilizer influenced grain yield of barley as NPS rate increased, also the grain yield increased. For instance in this year they recorded, application of the highest level NPS (200kg ha⁻¹) resulted in the highest record of grain yield (48.76qt ha⁻¹) while the smallest (28.25qt ha⁻¹) was recorded due to control (0 kg/ha NPS). In general, increasing NPS application rate increases the grain yield of food barley over the lowest rate. The highest grain yield of food barley at the highest NPS rate might be improved root growth and increased uptake of nutrients and better growth favored due to interaction/synergetic effect of the three nutrients which enhanced yield components and yield.

Combined application NPS fertilizer showed yields and yield component are significantly increased according to the report of [28]. Similarly, the combined application of NPS fertilizer significantly increased spike length, Number of grains spike⁻¹, 1000-grain weight and grain yield by the crop [9, 31, 50, 51, 66].

Even if, application of the highest rate of NPS fertilizer increases N use efficiency and thus mines, soil N when N is in short supply [60].

The number of productive tillers/plant was affected significantly by NPS fertilizer application [3]. Similarly, the uses of the higher rate of NPS fertilizer significantly increased the plant height, spike length, number of total tiller and productive tiller [64]. In addition, Blended NPS fertilizer and supplemental N rates were significantly affected on total and productive number of tillers; Number of kernels per spike; aboveground dry biomass and thousand kernels weight [33].

According to researcher, who found that application of the higher rate of NPS blended fertilizer increased the biomass of food barley [68]. This due to Sulfur enhanced the formation of chlorophyll and encouraged vegetative growth and B helps in N absorption [44].

Research results showed that, the application of the highest rate of NPS fertilizer on food barley, grain yield increased from 678 to 1617 kg ha⁻¹ as compared to the lowest fertilizer rate of NPS. Application NPS fertilizers at rates of 9/10 to 18/20 kg ha⁻¹ NPS which are sub-optimal rates for food barley production [18].

Plant height of barley was increase with increasing rates of NPS fertilizer. Increase in NPS application increased N uptake, total biomass and grain yield [42, 62]. In addition to this,

increasing rates of NPS fertilizer application significantly enhanced growth, yield and nutrient uptake of barley [35].

4. Conclusion

The yield of crop is depending upon the combined effect of many factors. Among these factors, the production and productivity is declining from time to time because of lack of combined application of input like recommended amount of fertilizers and management practices. Based on the review on the effect NPS fertilizer rate on phenology, growth and yield parameters of food barley in, the following points concluded as major points;

As we have reviewed in different sources of literatures or journal papers all parameters like days to heading and maturity, number of tillers and plant height, of food barley were increased with NPS fertilizer rates increased. Even if grain yield of barley is increased with increasing NPS fertilizers rates. This indicates that production of food Barley can be increased by providing balanced soil fertilizers.

5. Recommendation

For food Barley production the following policy measures will be recommended.

The production and productivity of food Barley is affected by different factors as listed in the conclusion parts, therefore, research on food Barley production that affects yield should be done by researcher's and possible solutions should be put down accordingly.

- 1) Nutritious fertilizers like blended fertilizers should be provided to the farmers on time at an affordable price.
- 2) We should or need to focus on micro nutrients that are considered useless by farmers as well as researchers because those micro nutrients deficiency today shows clinical symptoms at human beings especially on children and infant women.
- 3) Fertilizer suppliers or cooperative unions should pay attention to supply or blended type of the fertilizer instead of supplying single elements, the fact that the government and recognized researchers should give due attention to blended fertilizer to increase production of food Barley.

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