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ORIGINAL ARTICLE

Study on Response of Barley Genotypes to Balanced Fertilization

Irfan Rashid Thokar [1], Masrat Jan [2], Chetna Ameta[3] Bhanwar Lal Jat [4*]
1 Department of Botany, Govt. MVM College Bhopal MP India
2 Department of Botany, Govt. MLB Girls PG (Autonomous) College Bhopal MP India
3. Department of Agriculture, Bhagwant University Ajmer, Rajasthan India
4* Department of Agricultural Biotechnology Bhagwant University Ajmer Rajasthan India

ABSTRACT
The experiment consisted of 14 treatment combination comprising of two dual purpose barley varieties and seven balanced fertilization. These were evaluated under RBD with three replications. Dual purpose barley variety RD2715 significantly enhanced plant height, total tillers and DMA at successive growth stages before and at green fodder cutting as compared to variety RD2552. Variety RD2715 produced significantly higher green fodder yield over variety RD 2552. The extent of increase was 12.25%. These improvements manifested in the production of higher number of effective tillers, ear length, grains ear^{-1}, grain weight ear^{-1} and test weight in variety RD2552 with the concomitant increase in productivity in terms of grain, straw and biological yield. The magnitude of increase was to the tune of 6.12, 11.26 and 9.25%, respectively over variety RD2715. Variety RD2715 exhibited significantly higher N, P, K, S and Zn uptake in green fodder while variety RD2552 accumulated significantly higher N, P, K, S and Zn in grain and straw. Both varieties equally viable as both varieties viz., RD2715 and RD2552 fetched net return of Rupee 80138 and 79485 with B/C ratio 3.57 and 3.55. The results showed that balanced fertilization involving various nutrients combination viz., N, NP, NPK, NPKS, NPKZn and NPKSZn significantly improved growth, yield attributes thereby productivity and profitability of dual-purpose barley crop compared to no fertilization. Addition of P to N, K to NP and Zn to NPK failed to show their effectiveness on barley productivity compared to sole application of N, NP, NPK, respectively. Balanced fertilization comprising NPKSZn nutrients proved most effective in improving overall growth of crop before and after green fodder cutting closely followed by NPKS fertilization. These improvement due to NPKSZn and NPKS fertilization realized higher green fodder yield by 75.54, 70.84% over control and 14.35, 11.92% over NPK, respectively. Further crop under the influence of NPKSZn and NPKS fertilization produced significantly higher number of effective tillers m^{-1} row length, grains ear^{-1} grain weight ear^{-1} and test weight which ultimately gave significantly higher grain and straw yield by 14.67, 10.92 and 15.63, 11.41%, respectively over NPK. The corresponding increase in grain and straw yield over control was 65.05, 59.66 and 55.78, 50.10%. The application NPKSZn recorded maximum net returns and B/C ratio of 4.20 closely followed by NPKS fertilization with net returns and B: C ratio of 4.07 registering significantly higher over no fertilizer, N, NP and NPK fertilization.
Keyword: - *NPK, NPKSZn, NPKS, NPKZn, RD.*

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INTRODUCTION

Barley is a valuable crop because it is grown for several purposes such as food and processed food products for human being and feed for cattle and poultry birds. Barley grain is also valued for smothering and cooling effect on the body for easy digestion and as source of Vitamin B complex. Besides these conventional uses, it is an important industrial crop as it is used as raw material for beer, whisky and brewing industries. The small and marginal farmers of Rajasthan cut the green barley and feed it to farm and milch animals as a part of their nutrition. In recent past, India has made an impressive progress in achieving self-sufficiency in food grain production by elevating productivity of several crops. However, forage production for livestock is limited and costly due to erratic rainfall especially in Rajasthan. Barley is generally grown in areas where irrigation facilities are limited, as it can tolerate moisture and salt stress to a great extant. It possesses high total biomass, thus there has been an increasing interest in

exploiting it as a dual purpose cereal which can permit forage production in early season in addition to the grain yield later on. In India, barley was cultivated on 649 thousand hectare area during 2011-12 with 1608 thousand tones of production at an average productivity status of 24.8q ha^{-1}. In Rajasthan, barley was cultivated on 278 thousand hectare area during 2011-12 with 789.2 thousand tones of production at an average productivity status of 28.4q ha^{-1} [1-4]. This suggest an ample scope for growing dual purpose barley for obtaining moderate yield of green fodder as well as grain from the same crop. Growing of dual purpose barley genotypes having wider adaptability and responsive to inputs has opened a new avenue for exploiting higher green fodder and subsequent grain yield potential. Several authors have agreed upon the importance of rapid regeneration of leaf area after forage removal to establish sufficient photosynthetic capacity to support maximum grain yield. Thus identification of high yielding adaptable dual purpose varieties as per crop growing situation is considered to be the first and foremost step for development of production technology. It is established fact that green fodder and grain yield potentials of the dual purpose barley genotypes are realized to the fullest extent when they are grown under optimum agro-climatic environment. Adequate mineral fertilization is considered to be one of the most important pre-requisite in this respect. Despite the application of recommended quantities of major nutrients, the increase in yield is not encouraging. This indicates that in addition to major nutrients. There is need to supply secondary and micro nutrients. The factor productivity of N as well as P has gone down with the passage of time due to deficiency of other nutrients such as K, Zn, S, Fe and soon. Balanced nutrition of plants is one of the most important factors determining ultimate crop productivity. However, continuous cropping with only N and NP containing fertilizers, that to at sub optimum levels and neglected multi nutrients deficiencies leading to imbalance nutrients in soil and poor fertilization of applied nutrients as well as other production inputs. Nutrients removal from soil by crop must be restored by their application so as to maintain soil fertility [5-8]. Therefore balanced use of fertilizer would be a major step for enhancing crop productivity. At least five essential nutrients are of wide spread practical importance. These are N, P, K, S and Zn. Considering these facts and paucity of research findings on these aspects in southern Rajasthan:- (i) To find out suitable dual purpose barley variety for Rajasthan (ii) To evaluate the effect of balanced fertilization on productivity of dual purpose barley. (iii) To arrive at an economically viable treatment.

MATERIALS AND METHODS

The field experiment entitled 'Response of Barley Genotype to Balanced Fertilization' was conducted during Rabi season of the year 2013-2014. The details of the experiment, materials used, techniques and criteria adopted for evaluation of treatments during the course of investigation are presented in this chapter.

Physio-Chemical Properties of Soil:-Primary soil samples from different spots of experiment field were drawn mm up to 30cm before experimentation. A respective composite sample was prepared which was subtracted to physical, chemical and mechanical analysis to ascertain the physio-chemical properties of the experimental soils. The data shows that the soils of experimental field was clay loam in texture, slightly alkaline in reaction (pH 7.8), medium in available nitrogen (295.3kg ha^{-1}) and phosphorus (16.6kg ha^{-1}) and high in available potassium (275.7kg ha^{-1}).

Balanced Fertilization:-(i) Control (without any fertilizer):-F_0 (ii) N (60kg N ha^{-1}):-F_1 (iii) NP (N+20kg P_2O_5 ha^{-1}):- F_2 (iv) NPK (NP+20kg K_2O ha^{-1}):- F_3 (v) NPKS (NPK+40kg S ha^{-1}):- F_4 (vi) NPKZn (NPK+5kg Zn ha^{-1}):- F_5 (vii) NPKSZn:- F_6

Details of Crop Rising:-Field preparation:-After the harvest of kharif maize crop the field was ploughed with tractor drawn disc plough followed by two cross harrowing and planking to obtain well pulverized soil tilth. The field was then demarcated into different plot of 18.9m^2 with sufficient provision of irrigation channels.

Varieties:- (i) RD 2715:-It is a six row barley variety developed by RARS,, Durgapura for dual purpose utilization. It possesses high degree of resistance against yellow and brown rusts. First cut at 55 days after sowing gives better fodder yield. It starts heading in about 85 days and matures in about 120 days with average plant height of 70cm after cut and has 1000 grain weight of about 43g identified as dual purpose barley variety for timely sown irrigated condition of central zone.

(ii) RD 2552:-The dual purpose barley variety was developed from a cross between RD 2035 and DL 472 in 1997 and notified in 1999. It is medium tall in height and suitable for North-Eastern plains zone as well as North-Western plains zone under irrigated timely sown condition. The variety matures in 120-125 days and also suitable for saline alkaline soils.

Sowing:-As per the treatment, the seed of aforesaid varieties were sown on 25th November in furrows opened at 22.5cm apart and seeds were placed at a depth of 3-4cm using seed rate 100kg ha^{-1}.

Fertilizer application:-60kg N+20kg P_2O_5+20kg K_2O+40kg S +5kg Zn ha^{-1} were applied as per treatments. Urea, DAP, MOP, Gypsum and Zinc sulphate were used as source of nitrogen, phosphorus, potash, sulphur and zinc respectively. The total quantity of phosphorus, potash, sulphur, zinc and 1/3 dose of nitrogen were drilled in furrows before sowing. The remaining half nitrogen was applied in two equal solits i.e., at 30-35DAS and just after first cutting.

Irrigation:-For higher green fodder as well as subsequent grain yield the dual purpose barley crop was given three irrigations. For application of second dose and additional nitrogen, first irrigations were given at 30-35DAS. The last two irrigations were given at 55DAS and 95-100DAS.

Weed management:-In order to control weeds, 2,4-D @ 0.5kg ha^{-1} was sprayed as post emergence at 30 days after sowing with knap sac sprayer with flat nozzle using 450 L water ha^{-1}.

Harvesting:-Green fodder:-The dual purpose barley crop was harvested first for green fodder at 55 days after sowing. Plants from border area were harvested and removed from each plot. Thereafter, plants of net area were harvested, bundled and weighed separately to record green fodder yield per plot. It was converted to q ha^{-1}. After harvesting green fodder, the crop was raised for grain purpose.

Treatment Evaluation:-In order to evaluate effect of treatments on green fodder and its quality and subsequent growth, yield components, yield, nutrient content, uptake and other aspects of barley crop, observations were recorded for each parameter as per below mentioned methodology.

Growth characters:-Plant population m^{-1} row length:-The number of plants emerged were counted 25DAS in two randomly selected one meter row length of each plot and averaged to express as plant population per meter row length.

Plant height (cm):-At the time of green fodder cutting and final harvest, height of the five randomly tagged plants from each plot was measured from base of plant of plant to the tip of flag leaf/ear. The mean plant height for each treatment was computed and expressed in cm.

Dry matter accumulation (g/m^2):-The observation of dry matter accumulation was recorded periodically at 25, 40 days before green fodder cutting, at green fodder cutting and 25, 50 days after green fodder cutting and at final harvest. The plants from 0.5m row length were randomly selected in each of the plot and harvested up to ground level. These samples were dried in oven at 65°C for 72 hours to a constant weight. Thereafter, these were weighed and averaged to work out dry matter accumulation per 0.5m row length.

Total number of tillers (Tillers/m^2):-At green fodder cutting and grain crop harvest, total tillers from three randomly selected one m row length were counted in each of the plot and average number of total tillers m^{-1} row length was worked out.

Yield attributes:-Effective tillers:-The number of effective tillers was counted from three randomly selected one m row length in each plot at physiological maturity of the crop. These were averaged and effective tiller m^{-1} row length was computed.

Number of grains ear^{-1}:-From each experiment unit, five productive ears were randomly selected. After threshing and cleaning, grain were counted and expressed as number of grains ear^{-1}.

Ear length (cm):-Random sampling of five productive ears from each of the plot was carried out at physiological maturity and length of each ear was measured from base to tip of upper most spikelet and average ear length was computed under each experimental units.

Grain weight ear^{-1}:-The produce of above mentioned selected ears were weighed and divided by the total number of ears sampled, to estimate the grain weight ear^{-1}.

Test weight (g):-Grain sample was drawn after weighing of produce from each net plot yield. From these, 1000 grains were counted and weighed to record test weight.

Yield (q/ha):-Green fodder:-The dual purpose barley crop was harvested first for green fodder at 55 days after sowing. Plants from border area were harvested and removed from each plot. Thereafter plants of net area were harvested, bundled and weighed separately to record green fodder yield per plot. It was converted to q ha^{-1}. After harvesting green fodder, the crop was raised for grain purpose.

Grain (q/ha):-After threshing and winnowing grain yield of each net plot was weighed separately and recorded as grain yield in kg $plot^{-1}$. Thereafter, it was converted to q ha^{-1}.

Straw (q/ha):-Straw yield was computed by subtracting the corresponding grain yield from their total dry matter (biological yield) and expressed in terms of q ha^{-1}.

Biological:-Total dry matter (above ground) or biological yield was determined by weighing completely dried produce of individual net plot and computed in terms of q ha^{-1}.

Harvest index (%):-It is the ratio of economical yield (grain yield) to the biological yield which was worked out by following formula (Donald and Hamblin, 1976) and expressed in percent.

$$\text{Harvest index (\%)} = \frac{\text{Grain yield (q ha} - 1)}{\text{Biological yield (q ha} - 1)} * 100$$

Nutrient content and quality parameter:-Nutrient content:-The green fodder, grain and straw samples were collected at harvest from produce of each experimental unit and over dried at 70^{o}C to a constant weight and grinded in laboratory mill. These samples were subjected to chemical analysis for determination of nutrient content in green fodder; grain and straw the following standard method for analysis were adopted. (i) **Nitrogen:-** Nessler's reagent colorimetric method (Lindner, 1994) (ii) **Phosphorus:-** Vanadomolybdate phosphoric yellow colour method (Richards, 1968) (iii) **Potassium:-** Flame photometer method (Jackson, 1973) (iv) **Sulfur:-** Turbidemetric method (Tabatabai and Brenner, 1970) (v) **Zinc:-** Atomic absorption spectrophotometer (Lindsay and Norvell, 1978).

CP:-Crude protein **EE:**-Ether extract **CF:**-Crude fiber **NFE:**-Nitrogen free extract. Total digestible nutrients in percentage were calculated by the formula given by moore et al. (1953) as follow:-TDN (%)=Digestible crude protein (%)+Digestible crude fiber (%)+Digestible NFE (%)+[Digestible ether extract (%) x 2.25*] *Digestible fat was multiplied by 2.25 as fat contains 2.25 times more energy than carbohydrate and protein.

Nutrient uptake:-Uptake of N, P, K, S and Zn by green fodder, grain and straw was estimated by using following formula:-

$$\text{Nutrient uptake (kg ha} - 1) = \frac{\text{\%Nutrient content in green } \frac{\text{fodder}}{\text{grain}}\text{/straw} \quad \text{Yield of green fodder/grain/}}{100}$$

Results and Discussions

Plant Population:-A perusal of data reveals that dual purpose barley varieties and balanced fertilization did not significantly influence on number of plant m^{-1} row length recorded at 25DAS.

Growth Characters before and AT Green Fodder Cutting:-The data on various growth parameters of dual purpose barley varieties under the influence of balanced fertilization before and at green fodder cutting are presented in Table 4.1 and 4.2.

Plant height:-Varieties:-It is apparent from the data that at green fodder cutting variety RD2715 attained highest plant height of 79.96cm which was significantly higher by 7.03cm and 10.88cm over variety RD2552 and local, respectively.

Balanced fertilization:-Data show that balanced fertilization significantly influenced plant height at green fodder cutting. Application of N, NP, NPK, NPKZn, NPKS and NPKSZn at recommended level registered significant improvement in plant height by 8.81, 12.42, 13.17, 14.76, 13.27 and 22.32cm over no fertilization. The maximum plant height was recorded under conjoint application of NPKSZn which was significantly higher by 6.04 and 5.97cm respectively over NPK and NPKZn.

Total tillers m^{-1} row length:-Varieties:-Data presented in Table 4.1 indicate that varieties brought about significant variation in number of total tillers recorded at green fodder cutting. Variety RD2715 produced higher number of total tillers m^{-1} row length which was significantly superior over variety RD2552 and 19.79 by 9.61%, respectively.

Balanced fertilization:-Application of nutrients in different combination at recommended level significantly increased total tillers over no fertilization. Thus when compared to total tillers of 100.27 produced under no fertilization, application of N, NP, NPK, NPKS, NPKZn, and NPKSZn increased these by 26.43, 31.55, 31.93, 33.81, 32.79 and 41.65%, respectively. The crop under the influence of NPKSZn fertilization resulted in higher number of total tillers m^{-1} row length at green fodder cutting which showed significant increase over NPK and NPKZn to the tune of 7.36 and 6.67%, respectively.

Dry matter accumulation:-Varieties:-A perusal of data reveals that dual purpose barley variety RD2715 accumulated higher dry matter at 25, 40DAS and at green fodder cutting which was significantly higher by 8.57, 16.13 and 19.29 and 31.70, 27.43 and 33.04% respectively higher over RD2552 and local.

Balanced fertilization:-Data show that balanced fertilization involving combination of various nutrients significantly influenced DMA 0.5 m^{-1} row length at successive growth stages. Thus compared to no fertilization, application of N, NP, NPK, NPKZn, NPKS and NPKSZn at recommended level increased DMA at 25DAS by 14.80, 20.21, 20.72, 26.25, 25.61, 38.61% and at 40DAS by 14.47, 15.80, 24.54, 32.48, 32.25,

43.86%, respectively. While corresponding increases in DMA at green fodder cutting was 30.20, 31.92, 51.78, 57.56, 57.03, and 81.12, 63.14, 75.67 and 85.15%.

Plant height:-Varieties:-It is evident from data that at harvest dual purpose barley variety RD2715 attained highest plant height of 90.72cm which was significantly higher by 6.94 and 20.90cm over variety RD2552 and local.

Balanced fertilization:-The corresponding increases were to the extent of 10.11, 12.66, 13.81, 22.64, 17.09, 22.85cm, respectively. Further the magnitude of difference between N and NP as well as NP, NPK and NPKZn was not substantial to attain significance. The maximum plant height of 87.64cm was recorded under the conjoint application of NPKSZn which was significantly higher by 7.95% over NPK.

Total tillers m^{-1} row length:-Varieties:-It is inferred from data that among dual purpose barley varieties, RD2552 produced significantly higher number of total m^{-1} row length at harvest by 6.58 and 21.43% as compared to variety RD2715 and local.

Balanced fertilization:-An assessment of data indicate that application of N and in conjunction with P, PK, PKZn, PKS and PKSZn at recommended level significantly increased total tillers m^{-1} row length over no fertilization. The extent of improvement in total tillers at harvest was by 20.09, 20.77, 20.97, 21.59, 21.33 and 29.94%, respectively.

Dry matter accumulation:-Varieties:-A perusal of data reveals that dual purpose barley varieties differed significantly with respect to DMA $0.5m^{-1}$ row length recorded at successive growth stages after green fodder cutting. Among varieties, RD2552 accumulated highest dry matter at 25, 50 days after green fodder cutting and at harvest over RD2715 and local. The magnitude of increase was 21.42, 21.48 and 21.42% higher over local at 25, 50 days after green fodder cutting and at harvest, respectively.

Balanced fertilization:-Data reflects that was significant effect of balanced fertilization on DMA $0.5m^{-1}$ row length at successive growth stages after green fodder cutting. Application N, NP, NPK, NPKZn, NPKS and NPKSZn at recommended level significantly increased DMA $0.5m^{-1}$ row length at 25 and 50 days after green fodder cutting over no fertilization. At crop harvest aforesaid fertility level significantly increased DMA $0.5m^{-1}$ row length by 17.96, 21.49, 26.01, 34.53, 27.62 and 43.14%, respectively. The crop fertilized with NPKSZn accumulated highest amount of dry matter $0.5m^{-1}$ row length at 25, 50 days after green fodder cutting and at harvest which was significantly higher by 14.94, 10.01 and 13.59% over NPK 13.35, 8.63 and 12.17% over NPKZn, respectively.

Yield Attributes:-The data on yield attributes of dual purpose barley varieties under the influence of balanced fertilization are furnished in Table 4.5.

Effective tillers:- Varieties:-A perusal of data reveals that dual purpose barley varieties brought about significant variation on effective tillers m^{-1} row length. Among varieties, RD2552 significantly enhanced effective tillers m^{-1} row length by 8.89 and 21.43% over RD2715 and local.

Balanced fertilization:-Data show that application of nutrients in different combination at recommended level significantly increased effective tillers m^{-1} row length over no fertilization. Thus when compared to 98.43 effective tillers produced under no fertilization, application of N, NP, NPK, NPKZn, NPKS and NPKSZn increased these by 25.35, 26.66, 28.13, 28.00, 27.20 and 36.05%, respectively. The maximum showed numbers of effective tillers were recorded under NPKSZn fertilization which showed significant increase by 6.96%, respectively over NPKZn but was on a par with NPKS fertilization.

Ear length:-Varieties:-It is apparent from data that varieties brought about significant variation on ear length. Dual purpose barley variety RD2552 attained maximum ear length of 16.95cm which was significantly higher 0.73cm over variety RD2715 and 2.99cm over local.

Balanced fertilization:-An assessment of data presented in Table 4.5 indicates that are length was significantly influenced due to combined application of various nutrients over no fertilization. Thus when compared to ear length of 11.82cm under no fertilization, application of N, NP, NPK, NPKZn, NPKS and NPKSZn at recommended level significantly enhanced ear length by 4.38, 4.46, 4.50, 4.57, 4.47 and 5.04cm, respectively. The crop fertilized with NPKSZn produced ears having highest ear length of 16.96cm which was significantly higher over NPK and NPKZn by 3.31 and 3.50%, respectively. This nutrient combination was closely followed by NPKS which was found significantly increased ear length remain at par the by 6.20% over NPK and NPKZn.

Grain ear^{-1}:-Varieties:-It is explicit from the data that dual purpose barley variety RD2552 produced highest number of grains ear^{-1} registering significantly higher by 5.25% over variety RD2715 and 18.59 over local.

Balanced fertilization: An examination of data show that application of N at recommended level and in conjunction with P, PK, PKZn, PKS and PKSZn significantly improved grains ear^{-1} by 11.35, 30.06,31.92, 39.06, 38.43, and 47.22%, respectively over no fertilization. The highest numbers of grain ear^{-1} were

recorded under NPKSZn fertilization which registered significant increase by 11.60, 5.88 and 6.35% respectively over NPK, NPKS and NPKZn.

Grain weight ear^{-1}:-Varieties:-Data show that among dual purpose barley varieties, RD2552 exhibited significantly higher weight of grain ear^{-1} by 3.50% over variety RD2715.

Balanced fertilization:-It is inferred from the data presented in Table 4.5 indicate that application of N, NP, NPK, NPKZn, NPKS and NPKSZn significantly influenced grain weight ear^{-1} over no fertilization. The extent of increases was to the tune of 0.080, 0.09, 0.09, 0.09, 0.08 and 0.100g, respectively. Crop fertilized with NPKSZn produced ear having highest grain weight which showed significant increase by 4.4 and 2.71% respectively over NPK and NPKZn.

Test weight:-Varieties:-An examination of data reveals that dual purpose barley variety RD2552 attained significantly higher 1000 grain weight by 3.57 and 21.46% RD2715 and local.

Balanced fertilization:-The corresponding increases were to the extent of 19.54, 19.63, 19.84, 20.12, 19.88 and 24.25% respectively. The highest test weight was recorded under the conjoint application of NPKSZn fertilization which was significantly higher by 3.68, 3.43 and 3.65%, respectively over NPK, NPKS and NPKZn.

Yield and Harvest Index:-Data on crop productivity recorded in terms of green fodder, grain, strew and harvest index under the influence of various treatments are presented in Table 4.6.

Green fodder yield:-Varieties:-A perusal of data reveals that dual purpose barley variety RD2715 produced significantly highest green fodder yield of 363.6q ha^{-1} which was significantly higher by 12.18 RD2552 and 35.59% over local. Data further revealed that RD2552 also recorded 20.86% higher green fodder as compared to local.

Balanced fertilization:-It is evident from data that balanced fertilization involving combination of various nutrients significantly increased green fodder yield. Thus when compared to least green fodder yield of 218.20q ha^{-1} realized under unfertilized condition, the crop fertilized with recommended dose of N, NP, NPK, NPKZn, NPKS and NPKSZn increased it by 33.36, 43.11, 48.90, 67.04, 61.25 and 74.10%, respectively. Among balanced fertilization, conjoint application of NPKSZn recorded highest green fodder yield of 379.88q ha^{-1} which showed significant increase by 16.93 and 7.97%, respectively over NPK and NPKZn fertilization.

Grain yield:-Varieties:-It is explicit from data Table 4.6 reveals that varieties brought about significant variation on grain yield. Dual purpose barley variety RD2552 recorded highest grain yield of 37.77q ha^{-1} registering significant increases of 6.12 and 21.45% over and local RD2715.

Balanced fertilization:-Data show that balanced fertilization through either of nutrient combinations significantly increased grain yield over no fertilization. Thus when compared to least grain yield of 25.17q ha^{-1} realized under unfertilized condition, the crop fertilized with recommended dose of N, NP, NPK, NPKZn, NPKS and NPKSZn increased grain yield by 31.18, 33.71, 35.49, 39.77, 36.82 and 40.88q ha^{-1} respectively.

Straw yield:-Varieties:-The data explicit almost similar trend in straw yield as observed in grain yield due to varieties. Dual purpose barley varieties RD2552 and RD2715 significantly enhanced straw yield to the tune of 21.42 and 9.14% over local variety.

Balanced fertilization:-It is explicit from data that crop fertilized with N, NP, NPK, NPKZn, NPKS and NPKSZn at recommended level produced significantly higher straw yield over no fertilization. The corresponding increases were 19.03, 21.54, 32.44, 48.05, 39.66 and 51.71%, respectively. Further the magnitude of difference in straw yield between N-NP, NP-NPK, NPK-NPKZn and NPKS-NPKZn was not substantial to attain significance. The application of S + Zn in combination with primary nutrients NPK produced highest straw of 65.42q ha^{-1} which was significantly higher by 14.55 and 8.64%, respectively compared to NPK and NPKZn fertilization but on a par with NPKS fertilization straw yield by 11.78%.

Biological yield:- Varieties:-An examination of data reveals that dual purpose barley variety RD2552 recorded significantly higher biological yield compared to varieties RD2715 and local. The extent of increase was 9.25 and 21.43%.

Balanced fertilization:-Data presented in show that balanced fertilization involving application of N only and in conjunction with P, PK, PKZn, PKS and PKSZn at recommended level significantly improved biological yield by 21.83, 26.10, 35.58, 51.70, 42.08 and 55.64%, respectively over no fertilization. Thus when compared to biological yield of 92.60q ha^{-1} under NPK, application of NPKSZn and NPKS increased it by 14.79 and 11.89% respectively. While the magnitude of increases in biological yield due to NPKSZn fertilization over NPKZn was to the tune of 9.54%.

Nutrient Content:-The estimate of N, P, K, S and Zn content in green fodder, grain and straw under influence of various treatments are presented in Table 4.7 to 4.9.

Nitrogen content:-Varieties:-It is explicit from data that among varieties tested, RD2552 brought about significantly higher N concentration in green fodder, grain and straw compared to variety RD2715 and local. The extent of increase in N content was 4.52, 7.75 and 6.45% and 14.92, 12.69, and 12.34% over RD2715 and local.

Balanced fertilization:-The soil enriched with fertility via addition of N and various nutrient combinations significantly improved N status of green fodder, grain and straw. Thus compared to no fertilization, application of N, NP, NPK, NPKZn, NPKS and NPKSZn, at recommended level elevated N status of green fodder by 7.31, 10.84, 12.47, 20.05, 13.28, and 20.60%, grain by 3.43, 11.42, 13.20, 17.76, 15.91, and 27.45% and straw by 15.31, 17.22, 20.10, 2679, 23.92, and 31.10%, respectively.

Phosphorus content:-Varieties:-A perusal of data reveals that among dual purpose barley varieties, RD2552 brought about significantly higher P concentration in green fodder, grain and straw by 4.38, 1.66 and 15.46 and 12.73, 12.80 and 12.81%, respectively over variety RD2715 and local one.

Balanced fertilization:-An examination of data presented in Table 4.7 indicate that crop under the influence of balanced fertilization exhibited significant improvement in P content in green fodder, grain and straw. Thus compared to no fertilization, application of N, NP, NPK, NPKZn, NPKS and NPKSZn significantly enhanced P content of green fodder by 5.52, 8.88, 8.97, 11.38 and 12.30%, grain by 2.60, 8.22, 8.25, 13.88, 12.57 and 16.08% and straw by 14.42, 20.27, 24.37, 34.70, 30.60 and 35.87%, respectively. The addition of P along with N significantly improved P content of these plant parts by 3.18, 5.47 and 5.11% respectively over sole N.

Potassium content:-Varieties:-Among varieties tested, RD2552 brought about significantly higher K concentration in green fodder, grain and straw over RD 2715 and local. The extent of increase was 3.69, 4.37, 19.76 and 12.68, 12.73%, respectively.

Balanced fertilization:- The crop fertilized with recommended dose of N, NP, NPK, NPKZn, NPKS and NPKSZn significantly increased K content of green fodder by 31.80, 41.56, 45.87, 53.56, 48.59 and 59.57% grain by 7.01, 10.52, 16.00, 24.85% and straw by 4.89, 5.96, 10.41, 11.92, 10.41, and 13.26%, respectively over no fertilization. Data further show that green fodder, grain and straw produced under NPKSZn fertilization had highest K concentration in green fodder, grain and straw which was significantly higher by 9.38, 7.62, 2.58 and 7.38, 6.92, 2.58%, respectively over NPK and NPKZn but remained at par with NPKS fertilization.

Sulphur content:-Varieties:-Data reveals that dual purpose variety RD2552 brought about significantly higher S concentration in green fodder, grain and straw over variety RD2715 and local. The magnitude of increase was 7.68, 10.61 and 12.30% over local.

Balanced fertilization:-A perusal of data reveals that compared to no fertilization, application of fertilizer N alone as well as in combination with P, PK, PKZn, PKS and PKSZn significantly improved S content of green fodder by 18.42, 20.94, 20.46, 39.87, 35.18 and 42.71% grain by 7.62, 10.30, 15.04, 21.73, 15.65 and 22.14% and straw by 11.94, 12.23, 17.91, 25.97, 21.79 and 28.06% respectively. Similarly highest S content of green fodder, grain and straw was estimated under combined application of all nutrients i.e., NPKSZn which showed significant increase in S content of green fodder, grain and straw by 14.67, 6.18, 8.61 and 5.58, 5.61, 5.15%, respectively over NPK and NPKZn fertilization.

Zinc content:-Varieties:-It is evident from data that varieties differ significantly with respect to Zn content in various plant parts. Dual purpose barley variety RD2552 registered highest concentration of Zn on green fodder, grain and straw and local contents least value.

Balanced fertilization:-The soil enriched with fertility via addition of N and various nutrient combinations at recommended level significantly increased Zn status of green fodder, grain and straw over no fertilization. Thus compared to no fertilization, application of N, NP, NPK, NPKS, NPKZn and NPKSZn elevated Zn status of green fodder by 6.08, 10.70, 12.56, 18.84, 17.76, 19.43%, grain by 17.04, 17.65, 18.71, 24.00, 27.34, 29.68% and straw by 13.54, 14.00, 14.46, 17.60, 20.12 and 23.49%, respectively.

Nutrient uptake:-The estimate of N, P, K, S and Zn uptake by green fodder, grain and straw of dual purpose barley varieties under the influence of balanced fertilization are presented in Table 4.10 to 4.12.

Nitrogen uptake:-Green fodder:-Varieties:-An examination of data presented in show that dual purpose barley variety RD2715 accumulated highest quantum of N by green fodder which was significantly higher by 6.41 and 48.59% over variety RD2552 and local.

Balanced fertilization:- The maximum N uptake by green fodder was estimated under the influence by NPKSZn fertilization which was significantly higher over NPK and NPKZn by 23.63 and 18.21% respectively. This nutrient combination was closely followed by NPKS fertilization which showed

significant increase in N uptake by green fodder to the tune of 18.28% over NPK but remained at par with NPKZn fertilization.

Grain:-Varieties:-A perusal of data reveals that the grain produced due to variety RD2552 accumulated significantly higher N in grain by 15.64 and 36.87% over variety RD2715 and local.

Balanced fertilization:-Data reflects that compared to no fertilization, application of various nutrient combinations viz., sole N, NP, NPK, NPKZn, NPKS and NPKSZn at recommended level significantly improved N uptake by grain to the tune of 11.88, 18.93, 22.73, 32.84, 26.63, and 40.54kg ha^{-1}, respectively. The magnitude of increase in terms of percent increase with application of NPKZn was in order of 21.44, 10.83, 29.21, 37.79, 57.17 and 105.99, respectively over NPKZn, NPKS, NPK, NP, N and control.

Straw:-Varieties:-Data presented in Table 4.10 indicates that varieties brought about significant variation in N uptake by straw. The dual purpose barley variety RD2552 accumulated higher amount of N by straw which was significantly higher by 2.55 and 4.45kg ha^{-1} over RD2715 and local.

Balanced fertilization:-Crop fertilized with N, NP, NPK, NPKZn, NPKS and NPKSZn at recommended level accumulated significantly higher quantum of N in straw compared to unfertilized one. The corresponding increases were 37.02, 42.76, 58.90, 87.51, 72.93, and 98.34%, respectively. The addition of S and Zn in combination with primary nutrients NPK maximized N uptake by straw which was significantly higher by 24.83 and 14.70%, respectively over NPK and NPKZn but at par with NPKS fertilization.

Phosphorus uptake:-Green fodder:-Varieties:-A perusal of data reveals that dual purpose barley variety RD2715 accumulated significantly higher P in green fodder compared to variety RD2552 and local. The extent of increase was 7.44 and 47.10%, respectively.

Balanced fertilization:-Data show that application of N only and in conjunction with P, PK, PKZn, PKS and PKSZn at recommended level significantly enhanced P uptake by green fodder over no fertilization. The corresponding increases were 41.00, 55.99, 62.91, 86.62, 69.78 and 95.10%, respectively. Further the conjoint application of NPKSZn remained at par with NPKS but these nutrient combinations significantly increased P uptake by 19.75 and 14.55% respectively over NPK.

Grain:-Varieties:-It is evident from data presented in reveals that dual purpose barley variety RD 2552 significantly P uptake by grain to the tune of 8.65 and 36.97% over that of variety RD 2715 and local.

Balanced fertilization:-The crop fertilization with N, NP, NPK, NPKZn, NPKS and NPKSZn at recommended level significantly improved P uptake by grain to the extent of 29.88, 45.22, 53.11, 80.00, 64.77, 88.56%, respectively over no fertilization. Thus when compared to NPK and NPKZn, application of NPKSZn increased P uptake by grain to the tune of 23.15 and 14.40%, respectively.

Straw:-Varieties:-Data presented in Table 4.10 indicates that varieties brought about significant variation in P uptake by straw. Dual purpose barley variety RD2552 accumulated higher amount of P by straw which was significantly higher by 28.27 and 36.83% over RD2715 and local.

Balanced fertilization:-The balanced fertilization including application of N alone and in conjunction with P, PK, PKZn, PKS and PKSZn at recommended level significantly increases P uptake by straw over no fertilization. The corresponding increases were 34.82, 44.64, 63.39, 98.21, 81.25 and 103.12%, respectively. Further crop fertilized with nutrient combination of NPKSZn accumulated highest quantum of P in straw which was significantly higher by 24.31 and 12.07%, respectively over NPK and NPKZn fertilization.

Potassium uptake:-Green fodder:-Varieties:-Data indicate that green fodder produced by dual purpose barley variety RD2715 accumulated highest K uptake registering significant increase of 8.52 and 48.46% over RD2552 and local.

Balanced fertilization:-The application of N, NP, NPK, NPKZn, NPKS and NPKSZn at recommended level enhanced K uptake by green fodder to the extent of 75.18, 100.66, 117.65, 157.55, 129.88 and 175.68%, respectively over no fertilization. However addition of K along with NP significantly enhanced K uptake by 8.47% over sole NP. Thus when compared to NPK, balanced fertilization through NPKSZn and NPKS enhanced K uptake by green fodder to the extent of 26.66 and 18.33%, respectively.

Grain:-Varieties:-A perusal of data presented in Table 4.11 reveals that the grain produced due to dual purpose barley variety RD2552 accumulated significantly higher K in grain by 10.44 and 36.86% compared to RD2715 and local.

Balanced fertilization:-Data indicate that K accumulated by grain showed positive response to balanced fertilization involving combinations of various nutrients. Thus compared to least K uptake by grain under inherent fertility status, enrichment of soil with N, NP, NPK, NPKZn, NPKS and NPKSZn at recommended level significantly elevated K uptake by 35.32, 48.04, 63.47, 93.73, 70.64, and 102.53%, respectively.

Straw:-Varieties:-Data show that dual purpose barley variety RD2552 accumulated significantly higher K in straw over variety RD2715 and local. The magnitude of increase was 12.99 and 27.55%.

Balanced fertilization:-The corresponding increases were to the extent of 24.77, 28.62, 46.25, 65.50, 53.84 and 71.67%, respectively. Among balanced fertilization, addition of K along with NP significantly enhanced K uptake by 13.71% over sole, NP. The combined application of NPKSZn accumulated highest quantum of K in straw which remained at par with NPKS fertilization however both these nutrient combinations significantly increased K uptake by 12.36 and 3.00kg ha^{-1}**,** respectively over NPK. The magnitude of increase in K uptake by straw with NPKSZn fertilization was 11.60% over NPKZn fertilization.

Sulphur uptake:-Green fodder:-Varieties:-Data reflects that dual purpose barley variety RD2715 registered significantly higher S uptake by green fodder compared to variety RD2552. Thus when compared to S uptake by green fodder due to variety RD2715, RD2552 and local enhanced it by 6.33 and 39.11%, respectively.

Balanced fertilization:-Inclusion of P in N and K in NP failed to record perceptible variation over sole N and NP, respectively. Further addition of Zn with NPK significantly elevated S accumulation by green fodder to the tune of 12.81% over NPK alone. The crop fertilized with NPKSZn accumulated highest S in green fodder which remained at par with NPKS fertilization however both these nutrient combinations significantly enhanced S uptake by 34.60, 19.32 and 24.72, 10.56%, respectively over NPK and NPKZn fertilization.

Grain:-Varieties:-A perusal of data reveals that the grain produced due to dual purpose barley variety RD2552 accumulated significantly higher S in grain over RD2715 and local. The magnitude of increase was 14.41 and 34.23%.

Balanced fertilization: Data show that balanced fertilization significantly enhanced accumulation of S by grain compared to no fertilization. The magnitude of increases in S uptake with N, NP, NPK, NPKZn, NPKS and NPKSZn fertilization were 35.89, 47.24, 61.42, 91.71, 68.94 and 97.60%, respectively.

Straw:-Varieties:-An examination of data presented in show that dual purpose barley variety RD2552 and RD2715 significantly accumulated higher amount of S by straw as compared to local. The extent of increases was 36.52, 12.02%, respectively.

Balanced fertilization:- The corresponding increases were to the tune of 32.31, 35.39, 55.03, 85.08, 68.79 and 93.36%, respectively. The combined application of NPKSZn accumulated highest quantum of S in straw which remained at par with NPKS however both these nutrient combinations significantly increased S uptake by 24.72 and 19.38%, respectively over NPK sole. The magnitude of increase in S uptake by straw with NPKSZn over NPKZn fertilization was 14.56%.

Zinc uptake:-Green fodder:-Varieties:-A perusal of data reveals that varieties brought about significant variations in Zn uptake by green fodder. Dual purpose barley variety RD2715 accumulated highest quantum of Zn in green fodder which was significantly higher by 6.93 and 39.80% over RD2552 and local.

Balanced fertilization:-The application of N, NP, NPK, NPKZn, NPKS and NPKSZn at recommended level enhanced Zn uptake by green fodder to the extent of 41.60, 58.42, 66.98, 97.56, 82.18 and 107.29%, respectively over no fertilization. The crop fertilized with NPKSZn accumulated highest quantum of Zn in green fodder which was significantly higher by 24.14 and 13.78%, respectively over NPK and NPKZn but remained at par with NPKS. Thus when compared to NPK, the application of NPKS significantly elevated S uptake by green fodder to the tune of 18.32%.

Grain:- Varieties:-It is evident from data that grain produced by barley variety RD2252 accumulated highest Zn which was significantly higher by 13.37 and 30.74% over RD2715 and local.

Balanced fertilization:-The highest Zn uptake by grain was registered under NPKSZn fertilization which significantly increased Zn uptake by grain to the tune of 25.80 and 13.13%, respectively over NPK and NPKZn fertilization. This nutrient combination was closely followed by NPKS which significantly improved Zn uptake by grain. The extent of increase was 17.09%.

Straw: -Varieties:-Data show that dual purpose barley variety RD2552 registered highest Zn uptake by straw which was significantly higher by 20.20% over variety RD2715.

Balanced fertilization: The crop fertilized with N and in conjunction with P, PK, PKZn, PKS and PKSZn at recommended level significantly increased Zn uptake by straw over no fertilization. The corresponding increases were 35.35, 38.50, 51.12, 73.33, 66.69 and 86.89%, respectively. The addition of S + Zn in combination with primary nutrients NPK maximized Zn uptake by straw which was significantly higher by 23.67, and 12.12%, respectively over NPK and NPKZn fertilization.

Total Digestable Nutrient Content:-The estimate of total digestible nutrient content in green fodder under influence of various treatments is presented in Table 4.12.

Varieties:-Data reflects that dual purpose barley variety RD2715 recorded significantly higher percentage of TDN in fodder as compared to RD2715 and local.

Balanced fertilization:-When compared to no fertilization, application of NPK, NPKZn, and NPKSZn at recommended level significantly increased TDN in green fodder by 0.32, 0.29 and 0.57%, respectively. The highest TDN content was estimated under the conjoint application of NPKSZn.

Varieties:-A perusal of data reveals that both dual purpose barley varieties the magnitude of increase was Rs 18548 and Rs 17937 ha^{-1} with RD2715 and RD2552 over local under study was found significantly superior over local with respect to net returns and B/C ratio.

Balanced fertilization:-The crop fertilized with NPKSZn fetched highest net returns of Rs 90741 ha^{-1} registering gains of Rs 9686, 15205, 19442, 23731 and 42464 ha^{-1} over NPKZn, NPK, NP, N and no fertilization. The nutrient combination NPKS was found next in order which fetched net returns of Rs 87203 ha^{-1} registering gains of Rs 6148, 11667, 15904, 20193 and 38926 ha^{-1} respectively over NPKZn, NPK, NP, N and no fertilization but fetched reduced net returns by Rs 3538 ha^{-1} over NPKSZn fertilization.

Varieties:-Data presented in Table 4.14 reveals that maximum content of N, P and K after harvest of barley crop is obtained in the plot of local genotype sown as compared to RD2552 and RD2715.

Balanced fertilization:-A critical examination of data reveals that all the treatment of balanced fertilization were found at par to each other in P and K status of soil after harvest the barley crop and found significantly higher over no fertilization However, treatment NPKSZn recorded significantly maximum sulphur and Zn (ppm) content in soil after the harvest.

Table-4.1-Effect of Response barley Genotypes to balanced fertilization on plant population, plant height and total tillers before and at green fodder cutting (55 DAS)

Treatments	Plant population (m^{-1} row length. (25 DAS)	Plant height (cm)	Total tillers (m^{-1} row length.)
Varieties			
RD 2715	451.23	79.96	140.50
RD 2552	451.53	72.93	128.18
Local	451.51	69.08	117.29
S.Em. ±	2.346	1.08	1.999
C.D. (P=0.05)	NS	3.10	5.714
Balanced Fertilization			
No fertilizer	450.95	66.00	100.27
N only	451.00	71.82	126.77
NP	452.20	74.20	131.91
NPK	451.19	74.69	132.29
NPKS	451.34	75.74	134.17
NPKZn	450.94	74.76	133.15
NPKSZn	452.35	80.73	142.03
S.Em. ±	3.583	1.66	3.054
C.D. (P=0.05)	NS	4.74	8.729

Table 4.2-Effect of Response barley Genotypes to balanced fertilization on dry matter accumulation before and at green fodder cutting (55 DAS)

Treatments	DMA (g $0.5m^{-1}$ row length)		
	25 DAS	40 DAS	At green fodder cutting (55 DAS)
Varieties			
RD 2715	10.51	42.92	54.60
RD 2552	9.68	36.96	45.77
Local	7.98	33.68	41.04
S.Em. ±	0.21	0.879	1.178
C.D. (P=0.05)	0.61	2.513	3.368
Balanced Fertilization			
No fertilizer	7.77	30.76	32.68
N only	8.92	35.21	42.55
NP	9.34	35.62	43.11
NPK	9.38	38.31	49.60
NPKS	9.81	40.75	51.49
NPKZn	9.76	40.68	51.32
NPKSZn	10.77	44.25	59.19
S.Em. ±	0.33	1.343	1.800
C.D. (P=0.05)	0.93	3.838	5.144

Table 4.3-Effect of Response barley Genotypes to balanced fertilization on plant height and total at harvest

Treatments	Plant height (cm)	Total tillers (m^{-1} row length)
Varieties		
RD 2715	90.72	164.52
RD 2552	83.78	175.35
Local	69.82	144.40
S.Em. ±	1.185	2.49
C.D. (P=0.05)	3.386	7.13
Balanced Fertilization		
No fertilizer	71.34	135.62
N only	78.55	162.87
NP	80.37	163.79
NPK	81.19	164.06
NPKS	87.49	164.90
NPKZn	83.53	164.55
NPKSZn	87.64	175.28
S.Em. ±	1.810	3.81
C.D. (P=0.05)	5.173	10.89

Table 4.4-Effect of Response barley Genotypes to balanced fertilization on dry matter accumulation after green fodder cutting

Treatments	DMA (g $0.5m^{-1}$ row length)		
	25 DAFC	50 DAFC	At harvest
Varieties			
RD 2715	50.47	55.06	63.30
RD 2552	53.18	61.69	71.25
Local	43.80	50.78	58.68
S.Em. ±	0.919	1.135	1.376
C.D. (P=0.05)	2.627	3.244	3.934
Balanced Fertilization			
No fertilizer	39.21	45.02	51.78
N only	47.23	53.43	61.08
NP	49.10	55.04	62.91
NPK	49.27	57.12	65.25
NPKS	52.64	59.62	69.66
NPKZn	49.96	57.85	66.08
NPKSZn	56.63	62.84	74.12
S.Em. ±	1.404	1.734	2.102
C.D. (P=0.05)	4.013	4.956	6.009

Table 4.5-Effect of Response barley Genotypes to balanced fertilization on yield attributes

Treatments	Yield attributes				
	Effective tillers (m^{-1} row length)	Ear length (cm)	Grains ear^{-1}	Grain weight ear^{-1} (g)	Test weight (g)
Varieties					
RD 2715	122.90	16.22	18.90	0.57	29.62
RD 2552	133.82	16.95	19.90	0.59	30.68
Local	110.20	13.96	16.78	0.48	25.26
S.Em. ±	1.811	0.115	0.239	0.002	0.142
C.D. (P=0.05)	5.175	0.328	0.683	0.006	0.405
Balanced Fertilization					
No fertilizer	98.43	11.82	14.44	0.47	24.25
N only	123.38	16.20	16.08	0.55	28.99
NP	124.67	16.28	18.78	0.56	29.01
NPK	126.12	16.32	19.05	0.56	29.06
NPKS	125.99	16.39	20.08	0.56	29.13
NPKZn	125.20	16.29	19.99	0.55	29.07
NPKSZn	133.92	16.86	21.26	0.57	30.13
S.Em. ±	2.766	0.175	0.365	0.003	0.217
C.D. (P=0.05)	7.905	0.500	1.043	0.009	0.619

Table 4.6-Effect of Response barley Genotypes to balanced fertilization on yield and harvest index

Treatments	Yield (q ha^{-1})				
	Green Fodder	Grain	Straw	Biological	Harvest index (%)
Varieties					
RD 2715	365.59	35.59	55.67	91.26	39.07
RD 2552	325.87	37.77	61.94	99.71	37.79
Local	269.62	31.10	51.01	82.11	37.79
S.Em. ±	5.686	0.728	0.998	1.316	0.565
C.D. (P=0.05)	16.251	2.081	2.924	3.761	NS
Balanced Fertilization					
No fertilizer	218.20	25.17	43.12	68.30	36.90
N only	290.93	31.88	51.33	83.21	38.31
NP	312.28	33.71	52.41	86.12	39.25
NPK	324.89	35.49	57.11	92.60	38.31
NPKS	364.99	39.77	63.84	103.61	38.34
NPKZn	351.85	36.82	60.22	97.04	37.94
NPKSZn	379.88	40.88	65.42	106.30	38.49
S.Em. ±	8.685	1.112	1.668	2.010	0.864
C.D. (P=0.05)	24.824	3.179	4.728	5.746	NS

Table 4.7-Effect of Response barley Genotypes to balanced fertilization N and P content by green fodder, grain and straw

Treatments	N content			P content		
	Green Fodder	Grain	Straw	Green Fodder	Grain	Straw
Varieties						
RD 2715	0.420	1.689	0.248	0.3443	0.3987	0.0595
RD 2552	0.439	1.820	0.264	0.3594	0.4053	0.0687
Local	0.382	1.615	0.235	0.3188	0.3593	0.0609
S.Em. ±	0.003	0.013	0.002	0.0014	0.0020	0.0008
C.D. (P=0.05)	0.008	0.037	0.006	0.0041	0.0056	0.0024
Balanced Fertilization						
No fertilizer	0.369	1.515	0.209	0.3154	0.3564	0.0513
N only	0.396	1.567	0.241	0.3328	0.3657	0.0587
NP	0.409	1.688	0.245	0.3434	0.3857	0.0617
NPK	0.415	1.715	0.251	0.3437	0.3858	0.0638
NPKS	0.443	1.784	0.265	0.3513	0.4059	0.0691
NPKZn	0.418	1.756	0.259	0.3447	0.4012	0.0670
NPKSZn	0.445	1.931	0.274	0.3542	0.4137	0.0697
S.Em. ±	0.004	0.020	0.003	0.0022	0.0030	0.0013
C.D. (P=0.05)	0.014	0.056	0.009	0.0062	0.0086	0.0036

Table 4.8-Effect of Response barley Genotypes to balanced fertilization N and P content by green fodder, grain and straw

Treatments	K content (%)			S content (%)		
	Green Fodder	Grain	Straw	Green Fodder	Grain	Straw
Varieties						
RD 2715	1.516	0.755	1.219	0.742	1.076	0.380
RD 2552	1.572	0.788	1.243	0.785	1.167	0.420
Local	1.395	0.699	1.184	0.729	1.055	0.374
S.Em. ±	0.014	0.005	0.011	0.005	0.009	0.003
C.D. (P=0.05)	0.039	0.014	0.031	0.014	0.027	0.008
Balanced Fertilization						
No fertilizer	1.066	0.656	1.124	0.597	0.971	0.335
N only	1.405	0.702	1.179	0.707	1.045	0.375
NP	1.509	0.725	1.191	0.722	1.071	0.376
NPK	1.555	0.761	1.241	0.743	1.117	0.395
NPKS	1.637	0.804	1.258	0.835	1.182	0.422
NPKZn	1.584	0.766	1.241	0.807	1.123	0.408
NPKSZn	1.701	0.819	1.273	0.852	1.186	0.429
S.Em. ±	0.023	0.008	0.017	0.007	0.014	0.004
C.D. (P=0.05)	0.066	0.022	0.048	0.021	0.041	0.012

Table 4.9-Effect of Response barley Genotypes to balanced fertilization on Zn content of green fodder, grain and straw

Treatments	Zn content (ppm)		
	Green fodder	Grain	Straw
Varieties			
RD 2715	11.35	20.99	14.68
RD 2552	11.90	22.42	15.80
Local	11.05	20.82	14.51
S.Em. ±	0.10	0.17	0.18
C.D. (P=0.05)	0.29	0.48	0.51
Balanced Fertilization			
No fertilizer	10.19	17.96	13.04
N only	10.81	21.02	14.84
NP	11.28	21.13	14.90
NPK	11.47	21.32	14.96
NPKS	12.11	22.27	15.37
NPKZn	12.00	22.87	15.70
NPKSZn	12.17	23.29	16.14
S.Em. ±	0.16	0.25	0.28
C.D. (P=0.05)	0.45	0.73	0.79

Table 4.10-Effect of Response barley Genotypes to balanced fertilization N and P content by green fodder, grain and straw

Treatments	N uptake (kg ha^{-1})			P uptake (kg ha^{-1})		
	Green Fodder	Grain	Straw	Green Fodder	Grain	Straw
Varieties						
RD 2715	38.53	60.16	13.97	31.64	14.22	3.36
RD 2552	36.21	69.57	16.52	29.45	15.45	4.31
Local	25.93	50.83	12.07	21.51	11.28	3.15
S.Em. ±	0.71	1.18	0.31	0.55	0.31	0.08
C.D. (P=0.05)	2.04	3.38	0.89	1.57	0.89	0.23
Balanced Fertilization						
No fertilizer	20.35	38.25	9.05	17.34	9.00	2.24
N only	29.33	50.13	12.40	24.45	11.69	3.02
NP	32.32	57.18	12.92	27.05	13.07	3.24
NPK	34.24	60.98	14.38	28.25	13.78	3.66
NPKS	40.50	71.09	16.97	32.36	16.20	4.44
NPKZn	35.81	64.88	15.65	29.44	14.83	4.06
NPKSZn	42.33	78.79	17.95	33.83	16.97	4.55
S.Em. ±	1.09	1.81	0.48	0.84	0.48	0.12
C.D. (P=0.05)	3.11	5.17	1.36	2.39	1.36	0.35

Table 4.11-Effect of Response barley Genotypes to balanced fertilization N and P content by green fodder, grain and straw

Treatments	K uptake (kg ha^{-1})			S uptake (k ha^{-1})		
	Green Fodder	Grain	Straw	Green Fodder	Grain	Straw
Varieties						
RD 2715	141.62	27.20	68.43	69.04	38.80	21.53
RD 2552	130.49	30.04	77.32	64.93	44.39	26.24
Local	95.39	21.95	60.62	49.63	33.07	19.22
S.Em. ±	2.25	0.59	1.43	1.22	0.93	0.42
C.D. (P=0.05)	6.44	1.69	4.08	3.50	2.65	1.21
Balanced Fertilization						
No fertilizer	58.87	16.59	48.61	32.63	24.60	14.61
N only	103.13	22.45	60.65	52.04	33.43	19.33
NP	118.13	24.56	62.52	56.91	36.22	19.78
NPK	128.13	27.12	71.09	60.75	39.71	22.65
NPKS	151.62	32.14	80.45	75.77	47.16	27.04
NPKZn	135.33	28.31	74.78	68.53	41.56	24.66
NPKSZn	162.29	33.60	83.45	81.77	48.61	28.25
S.Em. ±	3.44	0.90	2.18	1.87	1.42	0.65
C.D. (P=0.05)	9.84	2.59	6.23	5.34	4.05	1.85

Table 4.12-Effect of Response of barley Genotypes to balanced fertilization Zn uptake of green fodder, grain and straw and TDN in green fodder

Treatments	Zn uptake (g ha^{-1})			TDN in green fodder (%)
	Green Fodder	Grain	Straw	
Varieties				
RD 2715	1046.25	754.26	822.04	63.52
RD 2552	978.39	855.13	983.28	63.17
Local	748.41	654.08	747.70	62.87
S.Em. ±	19.72	17.21	16.193	0.04
C.D. (P=0.05)	56.37	49.19	46.285	0.12
Balanced Fertilization				
No fertilizer	560.68	452.91	566.32	63.00
N only	793.92	671.75	766.49	63.12
NP	888.25	713.11	784.38	63.10
NPK	936.20	758.38	855.80	63.20
NPKS	1107.70	887.98	981.63	63.04
NPKZn	1021.44	843.27	944.02	63.18
NPKSZn	1162.24	957.01	1058.40	63.36
S.Em. ±	30.13	26.29	25.136	0.05
C.D. (P=0.05)	86.11	75.14	71.842	0.15

Table 4.13-Effect of dual purpose barley varieties to balanced fertilization net returns (ha^{-1}) and B/C ratio

Treatments	Net returns (ha^{-1})	B/C ratio
Varieties		
RD 2715	80832	3.61
RD 2552	80221	3.58
Local	62284	2.78
S.Em. ±	1359	0.06
C.D. (P=0.05)	3883	0.17
Balanced Fertilization		
No fertilizer	48277	2.35
N only	67010	3.16
NP	71299	3.21
NPK	75536	3.31
NPKS	87203	3.79
NPKZn	81055	3.53
NPKSZn	90741	3.92
S.Em. ±	2075	0.09
C.D. (P=0.05)	5932	0.26

Table 4.14-Effect of Response of barley Genotypes to balanced fertilization Zn uptake of green fodder, grain and straw and TDN in green fodder

Treatments	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	S kg ha^{-1})	Zn (kg ha^{-1})
Varieties					
RD 2715	280.28	21.84	272.12	9.43	2.17
RD 2552	285.58	22.26	277.06	9.46	2.15
Local	291.42	22.71	282.50	9.59	2.13
S.Em. ±	2.346	0.184	2.187	0.076	0.011
C.D. (P=0.05)	6.704	0.526	6.252	NS	NS
Balanced Fertilization					
No fertilizer	285.29	19.77	247.46	8.21	1.98
N only	285.34	22.65	281.72	9.35	2.04
NP	286.54	22.74	282.84	9.39	2.12
NPK	285.53	22.66	281.90	9.35	2.16
NPKS	285.68	22.68	282.04	9.74	2.25
NPKZn	285.27	22.64	281.66	9.84	2.22
NPKSZn	286.68	22.75	282.97	10.59	2.30
S.Em. ±	3.583	0.281	3.341	0.116	0.016
C.D. (P=0.05)	NS	0.804	9.550	0.332	0.046

CONCLUSIONS

On the basis of one year of field experiment it may be concluded that sowing of barley variety RD 2552 fetched maximum grain yield (37.77qha^{-1}), straw yield (61.94qha^{-1}) biological yield (99.71qha^{-1}) and variety RD 2715 recorded maximum green fodder (365.59qha^{-1}). Among balanced fertilization treatment NPKSZn (60kg N + 20kg P_2O_5 + 20kg K_2O + 40kg S + 5kg Zn ha^{-1}) proved superior for enhancing barley productivity over other nutrient combination. This treatment recorded maximum green fodder (379.88qha^{-1}), grain yield (40.88qha^{-1}), straw yield (65.42qha^{-1}), and biological yield (106.30qha^{-1}), net returns (Rs. 90741ha^{-1}) with B/C ratio 3.92. However, these results are only indicative and need further experimentation to reach at more consistent and definite conclusion.

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