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# Influence of Nitrogen and Zinc on Growth and Yield of Multicut Fodder Sorghum (*Sorghum bicolor* (L.) Moench)

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## ABSTRACT

A field trail was conducted on multicut fodder sorghum at Agricultural College Farm Bapatla. Treatments consisted of four levels of zinc and an absolute control. Data were recorded on plant height, number of tillers per hill, drymatter accumulation, green fodder and dry fodder yield. With incremental increase in the nitrogen level from 40 to 160 kg ha$^{-1}$, there was a gradual and significant increase in growth and yield of multicut fodder sorghum. Application of Zn @10, 20, 30 kg ha$^{-1}$ could equally influence the growth and yield in fodder sorghum but were significantly superior over absolute control.

**Key words :** Multicut Fodder Sorghum, Nitrogen Levels, Zinc Levels

Sorghum (Sorghum bicolar (L.)) moench) is one of the most widely adapted forage crops and grown extensively during *kharif* and summer season because of high yield potential, better nutritive value with palatability and quick regrowing habit after first cut. Multicut sorghum is more advantageous in various ways such as saving in cost for establishing a new crop and high yield in shorter period because of rationing.

Fertilizer management is an important agronomic aspect and it includes proper application of macro and micro nutrients to get maximum quality forage (Verama *et al*., 2005). Fodder sorghum productivity in India is low because of insufficiency supply or sub optimal use of nutrients, in general and nitrogen and zinc in particular. Nutrient rich fodder sorghum is more advantageous in many ways such as high yield in shorter period and continuous supply of green fodder for a longer period (Shinde *et al*., 1987)

Nitrogen being one of the most important nutrients, play a vital role in growth, development and fodder quality improvement as it is the principle constituent of protein. Zinc regulates diverse enzymatic activities and act as a co-factor in variety of enzymatic system in plants. Zinc can affect carbohydrate metabolism at various levels. The activity of zinc containing enzyme carbonic anhydrate sharply declines with zinc deficiency and in extreme zinc deficiency, net photosynthesis of plants decline presumably due to chloroplast structure and inhibition of photosynthetic electron transfer. Milch animals fed with zinc deficit forage suffer from parakaretosis diseases (Labance *et al*., 1997). Hence it is required to supply sufficient nitrogen and zinc to realize better yield in multicut fodder sorghum.

## MATERIAL AND METHODS

The field experiment was conducted during *Rabi* and summer seasons of 2007-2008 at Agricultural College Farm Bapatla on clay loam soil, medium in available nitrogen, phosphorus, high in potassium and low in zinc status. Fodder sorghum variety SSG 59-3 was the test variety. The experiment was laid out in RBD with factorial concept with 13 treatments i.e. four nitrogen levels+ three zinc levels+ 1 control (Table 1) replicated thrice. Data at different stages of crop growth were collected by standard procedure.

## RESULTS AND DISCUSSION

A perusal of data (Table 1) on plant height revealed the plant height was significantly influenced by levels of nitrogen and zinc but not due to their interaction. Control treatment registered significantly shorter plants than the rest of the treatments during all the cuts. During the first cut the maximum plant height (264 cm) was recorded by the highest level of nitrogen application (160 kg

N ha$^{-1}$) which was significantly superior to rest of the treatments. Significantly, the lowest plant height (102 cm) was observed in the control treatment, with increased level of nitrogen from 40 to 160 kg N ha$^{-1}$. There was a gradual and significant increase in the plant height and different nitrogen levels differed significantly with one another.

During the second cut, applying nitrogen at different levels differed significantly with one another. There was a gradual increase in plant height from control to 160 kg ha$^{-1}$. Significantly the lowest plant height of 80 cm was recorded in control treatment and the highest (211.0 cm) was recorded in treatment that received 160 kg N ha$^{-1}$. During the third cut, nitrogen treatments followed the similar trend that was observed during the second cut. During the third cut the highest (177 cm) and lowest (58 cm) plant height was recorded in the treatments received 160 kg ha$^{-1}$ and 0 kg N ha$^{-1}$ respectively.

Application of zinc at 10, 20 and 30 kg ha$^{-1}$ resulted in a non-significant difference among themselves during first, second and third cuts. Even though the differences were non significant, the taller plants (233, 174 and 151) were observed in the treatments received 30 kg Zn ha$^{-1}$ during the first, second and third cuts respectively. The interaction between the nitrogen in vegetative growth in terms of taller plants was better noticed by several researchers like Verma *et al*. (2005). Application of Zn has no significant influence on plant height at all the 3 cuts. Similar non-significant impact of zinc on plant height was reported by Raj *et al.* (1989) and Verma *et al.* (2005).

The data (Table 1) indicated that the number of tillers hill$^{-1}$ in multicut fodder sorghum increased gradually from first to third cut. All the treatments were significantly superior to the control. The nitrogen level could not interact significantly with the levels of zinc at any stage of the observation. Application of nitrogen at 40, 80, 120 and 160 kg ha$^{-1}$ significantly influenced the number of tillers hill$^{-1}$ and there was a gradual and significant increase in number of tillers hill$^{-1}$ as the nitrogen level increased from 40 to 160 kg ha$^{-1}$. During the first, second and third cuts maximum number of tillers hill$^{-1}$ i.e. 3.3, 3.5 and 3.7 respectively were registered by applying 160 kg N ha$^{-1}$. It was followed by 120 kg N ha$^{-1}$. The least number of tillers hill$^{-1}$ was recorded in the treatment received 40 kg N ha$^{-1}$. The difference in number of tillers hill$^{-1}$ was found non significant due to 10, 20 and 30 kg Zn ha$^{-1}$ during first, second and third cuts. However, higher number of tillers hill$^{-1}$ (2.7, 3.0, and 3.2) was found in the treatment during the first, second and third cuts respectively. The reason for higher number of tillers hill$^{-1}$ in nitrogen treated plots could be attributed to the fact that nitrogen is the critical input for regulating growth process such as cell multifunction in meristematic region stored along with carbohydrates in storage organs and is involved in regrowth processes, especially since root growth of grasses is reduced by defoliation. Better available nitrogen at higher rate of application could be the reason for higher number of tillers hill$^{-1}$ in the current study. This was in accordance with findings of Sunil Kumar *et al*. (2004).

Results on drymatter accumulation (Table 1) revealed that it was highest during first cut and decreased in subsequent cut. The data also showed a significant influence of nitrogen and Zinc application on drymatter accumulation of multicut fodder sorghum over absolute.

Interaction effect of nitrogen and zinc was non significant at all the three stages of observation. There was a gradual and significant increase in dry matter accumulation with each increment in nitrogen dose. During all the cuts, the highest (9.69, 9.51 and 5.55 t ha$^{-1}$) was registered by the treatment receiving 160 kg N ha$^{-1}$ followed by 120 kg N ha$^{-1}$. The lowest drymatter was recorded in control *viz.,* 3.25, 2.40 and 1.19 during the first, second and third cuts, respectively. During all the cuts, the drymatter accumulation values with 10, 20 and 30 kg Zn ha$^{-1}$ was found statistically on a par. However, numerically higher drymatter accumulation values of 8.07, 6.86 and 4.31 t ha$^{-1}$ were registered during first, second and third cuts, respectively with 30 kg Zn ha$^{-1}$ treatment. The significant increase in drymatter accumulation with increase in fertilizer nitrogen might be due to taller plants, higher number of leaves plant $^{-1}$ and more number of tillers plant$^{-1}$. At higher level of nitrogen that provided larger photosynthetic surface area to intercept more radiant energy which might have resulted in more drymatter accumulation. Further, nitrogen is an integral part of protoplasm, amino acids, amides, nucleotides and nucleo-proteins which are essential for cell division, expansion and thereby higher

Table 1. Plant growth of multicut fodder Jower as influenced by various treatments.

| Treatment | Plant height | | | Number of tillers hill$^{-1}$ | | | Drymatter accumulation (t ha$^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| Levels of N (kg ha$^{-1}$) | First cut | Second cut | Third cut | First cut | Second cut | Third cut | First cut | Second cut | Third cut |
| 40 | 184 | 123 | 99 | 1.9 | 2.1 | 2.3 | 4.57 | 3.45 | 2.34 |
| 80 | 219 | 152 | 137 | 2.3 | 2.5 | 2.7 | 6.59 | 5.42 | 3.52 |
| 120 | 236 | 182 | 159 | 2.8 | 3.0 | 3.3 | 8.34 | 7.24 | 4.54 |
| 160 | 264 | 211 | 177 | 3.3 | 3.5 | 3.7 | 9.69 | 9.51 | 5.55 |
| SEm+ | 5.4 | 5.64 | 3.66 | 0.19 | 0.08 | 0.10 | 0.35 | 0.22 | 0.10 |
| CD (P=0.05) | 15.7 | 10.7 | 0.3 | 0.3 | 0.3 | 0.3 | 0.72 | 0.66 | 0.30 |
| Levels of Zn (kg ha$^{-1}$) | | | | | | | | | |
| 10 | 218 | 160 | 134 | 2.3 | 2.5 | 2.7 | 7.05 | 5.80 | 3.68 |
| 20 | 227 | 166 | 143 | 2.6 | 2.9 | 3.1 | 7.47 | 6.56 | 3.97 |
| 30 | 233 | 174 | 151 | 2.7 | 3.0 | 3.2 | 8.07 | 6.86 | 4.31 |
| SEm | 4.6 | 4.89 | 0.17 | 0.07 | 0.07 | 0.08 | 0.03 | 0.57 | 0.09 |
| CD (P=0.05) | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| Control | 102 | 80 | 58 | 1.4 | 1.6 | 1.8 | 3.25 | 2.40 | 1.19 |
| Rest | 226 | 167 | 143 | 2.6 | 2.8 | 3.0 | 7.53 | 6.51 | 3.99 |
| Sem | 6.89 | 7.19 | 4.66 | 0.11 | 0.11 | 0.12 | 0.04 | 0.28 | 0.13 |
| CD (P=0.05)20.1 | 20.1 | 10.1 | 13.6 | 0.3 | 0.3 | 0.4 | 0.92 | 0.84 | 0.39 |
| NXZn | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| CV (%) | 7.47 | 10.53 | 8.03 | 11.2 | 9.9 | 10.5 | 10.38 | 10.94 | 8.34 |

growth. On the other hand, it was also reported that nitrogen deficiency *hinder* growth process resulting in stunted growth, chlorosis and reduced drymatter accumulation. Similar favourable impact of N levels on drymatter accumulation was also reported by Gardner *et al*., 1988.

*Data* pertaining to the green fodder yield , (Table 2) revealed that the green fodder yield decreased from first cut to third cut. The data also showed that all the fertilized plots recorded significantly higher green fodder yield over absolute control. Further, there was significant difference among the N levels. The interaction of zinc did not attain the level of significant statistically. Each incremental dose of N fertilizer from 40 to 160 kg N ha$^{-1}$ significantly. At first cut 40, 80 120 and160 kg N ha$^{-1}$ significantly differed with one another. The highest green fodder yield (40.6 t ha$^{-1}$) was noticed with 160 kg ha$^{-1}$ followed by 120 kg N ha$^{-1}$ whereas, the lowest green fodder yield (9.7 t. ha$^{1}$) was found in control treatment , Similar trend was noticed during the 2$^{nd}$ and 3$^{rd}$ cuts also. Applying 10, 20, and 30 kg Zn ha$^{-1}$ was found significantly superior over control treatment. However, the treatments applied with 10, 20 and 30 kg Zn ha$^{-1}$ could not differ significantly with one another. There was small increase on green fodder with increase in Zn level from 10 kg Zn ha$^{-1}$ onwards. This trend was repeated during the second and third cut also.

Data pertaining to the dry fodder yield presented (Table 2) revealed that the dry fodder yield was the highest during the first cut and gradually decreased from first cut to third cut. The data also indicated significant influence of all fertilizer levels on dry fodder yield of multicut fodder sorghum over absolute control. Different levels of nitrogen differed significantly with one another during all the cuts. The highest dry fodder yield (15.6, 9.1 and 7.9 t ha$^{-1}$) was recorded by the application of nitrogen @ 160 kg ha$^{-1}$ and it was significantly the highest during the first, second and third cuts, followed by 120 kg N ha$^{-1}$Significantly

Table 2. Fodder yield of multicut fodder jower as influenced by various treatments.

| Treatment | Green fodder yield (t $ha^{-1}$) | | | | Dry fodder yield (t $ha^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|
| Levels of N (kg $ha^{-1}$) | First cut | Second cut | Third cut | Total | First cut | Second cut | Third cut | Total |
| 40 | 21.4 | 13.8 | 6.6 | 41.8 | 7.0 | 4.4 | 3.2 | 14.6 |
| 80 | 28.2 | 18.0 | 10.6 | 56.8 | 9.3 | 6.1 | 4.6 | 20.0 |
| 120 | 36.7 | 24.3 | 14.2 | 75.2 | 12.3 | 7.6 | 6.4 | 26.3 |
| 160 | 40.6 | 29.3 | 19.7 | 89.5 | 15.6 | 9.1 | 7.9 | 32.6 |
| SEm+ | 0.8 | 0.57 | 0.34 | | 0.30 | 0.23 | 0.15 | |
| CD (P=0.05) | 2.3 | 1.7 | 1.0 | | 0.9 | 0.7 | 0.4 | |
| Levels of Zn (kg $ha^{-1}$) | | | | | | | | |
| 10 | 29.9 | 20.4 | 11.6 | 61.9 | 10.6 | 6.4 | 5.0 | 22.0 |
| 20 | 32.0 | 21.4 | 12.9 | 66.3 | 11.1 | 6.8 | 5.5 | 23.4 |
| 30 | 33.2 | 22.3 | 13.8 | 69.3 | 11.5 | 7.3 | 6.0 | 24.8 |
| SEm | 0.69 | 0.50 | 0.29 | | 0.26 | 0.20 | 0.13 | |
| CD (P=0.05) | NS | NS | NS | | NS | NS | NS | |
| Control | 9.7 | 7.0 | 3.4 | 20.1 | 3.7 | 2.7 | 1.7 | 8.1 |
| Rest | 31.7 | 21.4 | 12.8 | 65.9 | 11.1 | 6.8 | 5.5 | 23.4 |
| Sem | 1.02 | 0.73 | 0.43 | | 0.39 | 0.30 | 0.19 | |
| CD (P=0.05)20.1 | 3.0 | 2.1 | 1.3 | | 1.1 | 0.9 | 0.6 | |
| NXZn | Ns | NS | NS | | NS | NS | NS | |
| CV (%) | 7.9 | 8.5 | 8.5 | | 8.8 | 10.9 | 8.8 | |

the lowest dry fodder yield 7.0, 4. 4 and 3.2 t $ha^{-1}$ was registered with the treatment received 40 kg N $ha^{-1}$ during the first, second and third cuts, respectively. Application of Zn @ 10, 20 and 30 kg $ha^{-1}$ significantly increased the dry fodder yield, over absolute control. However, application of 30, 20 and 10 kg Zn $ha^{-1}$ recorded statistically comparable dry fodder yields during the first, second and third cuts. Even though the differences were non-significant, higher dry fodder yield was registered by the application of 30 kg Zn $ha^{-1}$ drining all the stages of observation. Interaction between the factor levels of nitrogen and Zinc was non significant. The better performance at higher levels of nitrogen might be due to the cumulative effect of substantial improvement in growth characteristics *viz.,* plant height, number of leaves $plant^{-1}$, drymatter accumulation and higher green fodder yield through efficient metabolic activity and increase photosynthesis which ultimately reflected in increased dry fodder yield of multicut fodder sorghum. These results are in conformity with the findings of Ammaji and Suryanarayana (2003).

The results of experiment indicate that application of 160 kg N $ha^{-1}$ and 10 kg Zn $ha^{-1}$ resulted in the better growth and fodder Yield in multicut fodder sorghum.

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