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ADAPTABILITY AND PRODUCTION PRACTICES OF MILLET (KABOG) GROWN UNDER CSCST- BARILI CAMPUS CONDITION

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ABSTRACT

Studies on millet production practices were conducted at CSCST-Barili Campus research experimental site to determine: 1) the effects of the different methods of seeding, 2) individual effects of planting distance and plant density as well as their interaction effects, and 3) individual effects of the time and the rate of fertilizer application as well as the interaction effects of the two on the growth and yield performance of millet.

Planting seeds by dropping into holes (T1) resulted to a significantly higher plant height, aboveground and underground biomass, number of tillers and panicles per hill, panicle length, weight of panicle and weight of grains per panicle as compared when seeds were drilled along the furrows (T2) and by broadcasting (T3).

Plants planted at closer space (Pd1 and Pd2) had taller plant height than plants planted at wider space (Pd3). At 25cm x 25cm planting distance, plants had higher above ground biomass, more number of tillers produced as compared to the other planting distances (Pd1 and Pd3). Significant differences were observed in the result of the under-ground biomass, weight of panicle per hill, weight of grains per panicle and grain yield. Almost similar results were obtained in the number of tillers produce per hill.

In terms of plant density, more number of tillers and panicles per hill in D3 (3 plant/hill) than D1 (1 plant/hill) and D2 (2 plants/hill) were observed. But the length and weight of panicle as well as the weight of grains per panicle were lower in D3.

Significant differences were observed between plant distance and plant density in terms of number of days from planting to panicle initiation, plant height, above and underground biomass, number of tillers, weight of panicle per hill and grain yield per plot. While, not significant difference were observed in panicle length and weight of grains per panicle.

Plants applied with fertilizer at 30 DAP had higher results as compared to plants applied with fertilizer at 45 DAP. Significant difference was observed in the rate of fertilizer application in all the growth and yield parameters gathered.

Significant difference was observed in the rate of fertilizer application in all the growth and yield parameters gathered. Plant height was significantly affected by the rate of fertilizer applied while the underground biomass and weight of grain per panicle were significantly affected by the time of fertilizer application. Significant differences were observed between the interaction effect of rate and time of fertilizer application to the growth and yield of millet.

INTRODUCTION

Millets belong to a group of annual grasses, characteristically with small edible seeds which are generally borne on short, slim stalks. A good sources of energy, protein, vitamins and minerals just like rice, maize and sorghum. About 90% of the grain produced is used as human food, animal feed and as seed or as emergency catch crop (http://www.parc.gov.pk/milletdty.html).

Millet is, and has been, a stable grain for most of the world's population. For centuries in Northern China, Korea, and Japan, it serve as alternative for rice, and still is the primary grain for more than one-third of the population in the Orient. (wwwinnvista.com/health/foods/seeds/millet.htm). The crop is the perfect grain for drought-stricken areas. They are grown even in harsh environments where other crops grow or yield poorly.

http://www.ext.nodak.edu/extpubs/plants/hay/r1016w.htm claimed that millets are suited to less fertile soils and poorer growing conditions, such as intense heat and low rainfall.

In contrast, In Africa and Pakistan, although the percentage of millet consumption is rising steadily, but the vast and still expanding millet areas continue to produce low yield due to the production constraints like in-efficient sowing method, depleted soil fertility and no fertilization, and poor and improper crop stands.

There are some areas in Cebu that grows millet but only in small scale. This could be attributed to lack or information about the cultural management practices such as method of seeding, planting distance and plant density as well as rate and time of fertilizer application. It is therefore important that suitable millet production practices must be developed in order to improve yield and realize the potential of the locally grown millet in Cebu. Hence, the following studies were conducted:

Sub-study 1. Method of Seeding of Millet

Sub-study 2. Planting Distance and Plant Density of Millet (Kabog)

Sub-study 3. Rate and Time of Fertilizer Application

MATERIALS AND METHODS

Adaptability and production practices studies of millet (Kabog) grown under CSCST-Barili Campus condition were conducted which included the following:

Sub-study1. Method of Seeding;
Sub-study 2. Planting Distance and Plant Density; and
Sub-study 3. Rate and Time of Fertilizer Application.

Land Preparation

The experimental area was plowed twice at two weeks interval by a tractor. After the last plowing, the soil was pulverized thoroughly using bolos or pick mattock and any form of weed growth was removed to provide desirable condition for growth and development of the crop.

Experimental Design and Field Layout

Sub-study 1. Method of Seeding

The area was laid out in randomized complete block design replicated four times. Each replication was divided into three plots, each measuring 3m x 4m. Replications and treatment plots were separated by 0.5m alleyways to facilitate farm operations, management and data gathering. The treatments consisted of the following:

Main plots: Planting distance
- Pd1 - 20cm x 20cm
- Pd2 - 25cm x 25cm
- Pd3 - 30 cm x 30cm

Subplots: Plant density
- D1 - 1 plant per hill
- D2 - 2 plants per hill
- D3 - 3 plants per hill

Sub-study 3. Rate and Time of Fertilizer Application

The area was laid out also in split plot arranged in randomized complete block design with three replications.

The same plot size and alleyways used in sub-study 1 was followed. The main plots constituted the different time of fertilizer application and the subplots consisted of the different rates of fertilizer application. The following treatments were used in this study:

Main plots: Time of Application (side-dressing)
A - 30 days after planting (DAP)
B - 45 days after planting

Subplots: Rate of Application
T0 - control
T1 - 60-30-30 (organic & inorganic)
T2 - 90-45-45 (organic & inorganic)
T3 - 120-60-60 (organic & inorganic)
T4 - 30-30-30 (inorganic)
T5 - 90-45-45 (inorganic)
T6 - 120-60-60 (inorganic)

For T1, T2 and T3, the fertilizers used were a combination of organic (chicken dung) and inorganic fertilizers (urea and complete) while for T4, T5, and T6 were purely inorganic fertilizer. Chicken dung and complete were applied as "footing" or before planting while urea was side-dressed depending on the treatment specifications that was 30 and 45 days after planting.

Chicken dung and complete fertilizer combination was applied at 3.75 and 0.54 g/hill (T1), 5.6 and 0.81g/hill (T2), and 7.5 and 1.08 g/hill (T3) while the complete fertilizer at 1.4g/hill (T4), 2.0g/hill (T5) and 2.7 g/hill (T6). For urea, it was applied at 0.42 g/hill (T1and T4), 0.61g/hill (T2 and T5) and 0.81g/hill (T3 and T6) based on the treatment rates specified, respectively.

Planting

Sub-study 1. Method of Seeding

The seeds of millet were planted based on the different method specified in the treatments. For T1, the seeds were sown by dropping into holes at a distance of 25cm x 25cm; T2, the seeds were drilled in the furrows spaced at 1 foot between rows and T3, seeds were broadcasted. Seeds were applied at the rate of 15 kg/ha or 18 grams per plot.

Sub-study 2. Planting Distance and Plant Density

Millet seeds were drilled in rows at a distance specified in the treatments. Three wooden frames with nylon string spaced at 20cm x 20cm (Pd1), 25cm x 25cm (Pd2), and 30cm x 30cm (Pd3), respectively, were improvised. These frames served as a guide in planting the millet seeds at specified distance.

Sub-study 3. Rate and Time of Fertilizer Application

Millet seeds were drilled in rows at a distance of 25cm x 25cm after which the seeds were covered with a thin layer of soil to protect the seeds from birds and ants.

Thinning

One week after planting, seedlings were thinned into two plants per hill except in Sub-study 2. Thinning for sub-study 2 was based on the plant density specified in the treatments.

Fertilizer Application

Complete fertilizer (14-14-14) at the rate of 90-45-45 kg/ha or at 156 g/plot were applied before sowing the seeds. This was done by applying the fertilizer 4-5cm at the bottom of holes made and was covered with a thin layer of soil before seeds were sown. One month after planting, urea was side-dressed at the rate of 90-45-45 kg/ha.

The same rate and kind of fertilizers were applied for all sub-studies 1 and 2 except for sub-study 3 which was based on its treatment specifications.

Watering

Water was applied especially during the seedling stage up to one month of age. This was done when there was no rain and the soil began to dry up.

Weed Control

Weeding was done two to three weeks after planting or during the seedling stage of millet plants.

Control of Insect Pests and Bird Pests

Insect pests were controlled by spraying insecticides following the recommended dosage. Spraying was done during the seedling, vegetative and reproductive stages of the crop.

Student working assistant was hired to watch over the experimental area against bird pests infestation during the reproductive stage until termination of the study. Strings with plastics hang on it were also placed over the entire area to repel birds.

Harvesting

Millet plants were harvested when 90% of the grains in each plot had ripened. Harvesting was done by carefully uprooting the ten sample plants in each plot. It was then brought to the research laboratory for data collection.

Data Gathered

Data of the three sub-studies were taken from the ten sample plants per plot. The same agronomic and yield parameters were recorded for all sub-studies which included the following:

1. **Days from planting to panicle initiation**. This was taken by counting the number of days from planting to the time when 90% of the plants in each plot had initiated panicle.

2. **Days from planting to harvest.** This was determined by counting the number of days from planting to harvesting.

3. **Plant height (cm)**. This was obtained by measuring the sample plants in each plot from the ground level up to the tip of the tallest panicle at harvest.

4. **Aboveground and Belowground biomass (gm).** Tops and the whole root system per plant were weighed separately right after harvest.

5. **Number of tillers.** This was recorded by counting the number of tillers produced per plant in each treatment plot at harvest.

6. **Number of panicles per hill.** This was determined by counting the number of panicles per hill in each treatment

plot at harvest.

7. **Panicle length (cm).** This was taken by measuring the panicles per hill from the base to the tip of the panicle. The average length of panicle per hill was computed by dividing the total length of each panicle by the total number of panicles per hill. This was done at harvest.

8. **Panicle weight (gm).** This was obtained by weighing each panicle per hill, then the sum of all the panicle weight was divided by the number of panicles per hill.

9. **Weight of grains (gm).** This was determined by weighing the seeds obtained from all the panicles per hill and then the sum of all the grain weights was divided by the number of panicle per hill.

10. **Grain Yield (g/plot).** Total weight of grains per plot were recorded.

Data Analysis

Data of the different trials were consolidated, encoded and then analyzed using the SPSS 11.5 software following its specified experimental design. Differences were evaluated through Duncan's Multiple Range Test (DMRT) and T-test.

Table 1. Growth and yield performance of millet as affected by the method of seeding.

Treatment	DPPI	PH (cm)	AM (g/hill)	UM (g/hill)	NTH	NPH	PL (cm)	WPH (g/hill)	WGP (g/panicle)	GY (g/plo)
T1(dropping seeds into holes)	52	114.09a	43.74a	20.78a	3.0a	3.0a	46.13a	5.39a	7.19a	1037.5
T2 (drilling seeds in the furrows)	52	112.85a	21.89b	6.10b	2.0b	2.0b	44.36a	3.80b	3.59b	1087.5
T3 (broadcasting)	52	103.88b	17.95b	3.95b	2.0b	2.0b	41.35b	3.10b	2.52b	1000.0

Legend: DPPI – Days from planting to panicle initiation
PH - plant height
AM - Aboveground biomass
UM - Underground biomass
NTH - Number of tillers per hill
NPH - Number of panicle per hill
PL - Panicle length
WPH - Weight of panicle per hill
WGP - Weight of grains per panicle
GY - Grain yield per plot

Results showed that the number of days from planting to panicle initiation and to harvesting did not vary among treatments. Panicle initiation was noted 52 days after planting and plants were harvested 80 days after planting in all treatments. This suggests that the different seeding method had not affected the growth stages of the plant.

Planting seeds by dropping into holes (T1) resulted to a significantly higher plant height, aboveground and underground biomass, number of tillers and panicles per hill, panicle length, weight of panicle and weight of grains per panicle as compared when seeds were drilled along the furrows (T2) and by broadcasting (T3). It was evident in this result that planting seeds at regular spacing (T1) resulted to a better growth of plants. When seeds are sown at regular distance, competition is less for they are evenly distributed in the area. While, when seeds were drilled along the furrows or when seeds were broadcasted, there was an uneven growth of plants within the plot, some grew close to each other, thus, competition was high.

Grain yield per plot did not vary significantly among treatments. This could be accounted to varying plant population per plot. Although T1 had more number of panicles produced per hill and higher average weight in grains per panicle, there were more number of plants per plot for T2 and T3 than in T1. Thus, the positive effects on the yield components did not compensate for the fewer number of plants per unit area. The findings implied that millet can be planted using any of the methods used in this study.

Sub-study 2. Planting Distance and Plant Density

The area was laid out in split plot arranged in randomized complete block design with three replications. The same plot size and alleyways used in sub-study 1 was followed. The different planting distances were designated as the main plots and the different plant density served as the subplots. The treatments used consisted of the following:

Table 2: Planting Distance and Plant Density

Treatment	DPPI	PH (cm)	AM (g/hill)	UM (g/hill)	NTH	NPH	PL (cm)	WPH (g/hill)	WGP (g/panicle)	GY (g/plot)
PD1 (20X20m)	39a	140.44 a	70.44b	34.51a	4.0b	3.0b	41.30	6.37a	3.57a	1266.67a
Pd2 (25x25c)	39a	138.78a	82.81a	39.86a	5.0a	4.0a	42.30	6.23a	3.51a	1050.00a
Pd3 (30x30c)	40b	117.04b	51.08c	27.53b	4.0b	3.0b	41.45	5.00b	2.64b	433.33b

Legend: DPPI – Days from planting to panicle initiation; PH - plant height; AM - Aboveground biomass; UM - Underground biomass; NTH - Number of tillers per hill; NPH - Number of panicle per hill; PL - Panicle length; WPH - Weight of panicle per hill; WGP - Weight of grains per panicle; GY - Grain yield per plot

Almost similar results were obtained in the number of tillers produce per hill. Plants planted at 25 cm x 25 cm had more of tillers produced as compared to the other planting distances (Pd1 and Pd3). While no significant difference was observed in the panicle length in terms on the planting distance used in this study.

Significant differences were observed in the result of the under-ground biomass, weight of panicle per hill, weight of grains per panicle and grain yield. Almost similar results were obtained in the number of tillers produce per hill. Plants planted at 25 cm x 25 cm had more of tillers produced as compared to the other planting distances (Pd1 and Pd 2). The closer planting distances (Pd1 and Pd2) gained higher under-ground biomass, weight of panicle per hill, weight of grains per panicle as compared to plants planted at wider space (30cm x 30 cm).

It was noted that as the plant planted a closer distances (20 cm x 20 cm and 25 cm x 25 cm) produced higher weight of panicle per hill, weight of grain per panicle and grain yield than plants planted at more wider plant distance (30 cm x 30 cm). The yield performance of millet at wider planting distance maybe attributed to the weed competition. In contrast by the claimed of Raguro (2003) as cited by Gian et al., (2008) that the vigorous growth and high yield of almost all plants planted to a wider space could be attributed to less competition for sunlight and space between plants, but as observed in this study, the wider space between plants, the more uncovered space that resulted for the growth of unwanted plants. Agdag (1995) mentioned that millets are poor weed competitors, weeds is one of the reasons for unsatisfactory yield of the crop, especially at two weeks after planting.

Individual Effect of Planting Density on the Growth and Yield Performance of Millet

Table 3. Effect of plant density on the growth and yield performance of millet.

Treatment	DPPI	PH (cm)	AM (g/hill)	UM (g/hill)	NTH	NPH	PL (cm)	WPH (g/hill)	WGP (g/panicle)	GY (g/plot)
T1 (1plt/hill)	40	131.48	72.79	31.33	4b	3b	41.71ab	6.79a	3.68a	894.44
T2 (2plt/hill)	39	131.98	64.21	31.25	4b	3b	43.13a	5.85b	3.30a	994.00
T3 (3plt/hill)	40	132.80	67.33	37.32	5a	4a	40.21b	4.96c	2.74b	961.11

Legend: DPPI – Days from planting to panicle initiation
PH - plant height
AM - Aboveground biomass
UM - Underground biomass
NTH - Number of tillers per hill
NPH - Number of panicle per hill
PL - Panicle length
WPH - Weight of panicle per hill
WGP - Weight of grains per panicle
GY - Grain yield per plot

Plant density did not affect significantly the number of days to panicle initiation, plant height, aboveground and underground biomass and grain yield per plot. However, significant differences were observed with the other parameters. It can be noted that D3 (3 plant/hill) produced more number of tillers and panicles per hill as compared to D1 (1 plant/hill) and D2 (2 plants/hill). While, the length and weight of panicle as well as the weight of grains per panicle were significantly lower in D3. This shows that plants planted at higher density had more tillers and panicles produced but had shorter panicle length and lower grain weight. The lower grain weight per panicle in D3 could be accounted to the competition of plants within the hill. At higher plant density, more plants were competing for nutrients and light.

No significant differences was observed in grain yield per plot, however, D2 produced the highest grain yield of 994g per plot followed by D3 of 961.11g per plot while D1 had the lowest grain yield of 894.44g per plot. Slight differences in the grain yield were noted among the density used, which means that millet can be planted in any of the three density used in this study.

Interaction Effects of Planting Density on the Growth and Yield Performance of Millet

As shown in Table 4, significant differences were observed between plant distance and plant density in terms of number of days from planting to panicle initiation, plant height, above and underground biomass, number of tillers, weight of panicle per hill and grain yield per plot. While, not significant difference were observed in panicle length and weight of grains per panicle.

Plants planted at 25cm x 25cm planting distance with three plant density per hill had the highest plant height, above and underground biomass, number of tillers, weight of panicle per hill and grain yield per plot. The results implied that the optimum planting distance of 25cm x25cm allows the plants to grow vigorously with lesser weed competition. As mentioned by Agdag (1995) that it is generally accepted that narrow (> 30cm) are beneficial in reducing weed competition and increasing yield. In addition, optimum spacing normally allows sufficient air circulation around plants, and allows production practices like watering, fertilizer application, pesticide application more easy thus, resulting to a more positive growth and yield performance of the crop (http://strawberry.ifas.ufl.edu/plnatingfull.htm). This may be the reason that even the three plant density is more crowded than that of D1 (1 plant/hill) and D2 (2 plants/hill) still more higher plant height, above and underground biomass, number of tillers, weight of panicle per hill and grain yield per plot results as compared to the other planting distances and plant density used in this study.

Table 4. Interaction effect of planting distance and plant density on the growth and yield performance of millet.

Treatment	DPPI	PH (cm)	AM (g/hill)	UM (g/hill)	NTH	NPH	PL (cm)	WPH (g/hill)	WGP (g/panicle)	GY (g/plot)
Pd1(20cmx20cm) D1 (1plt/hill)	39 b	139.40a	77.63ab	38.38 b	4bc	4b	40.92	7.27a	4.08	1150.00ab
D2 (2plt/hill)	39 b	140.58a	66.67 b	30.57bc	4bc	3b	44.04	6.91ab	3.91	1516.67a
D3 (3 plt/hill)	39b	141.35a	65.03b	34.56bc	4bc	4b	38.94	4.92cd	2.73	1333.33ab
Pd2(25cmx25cm) D1(1plt/hill)	39b	135.00a	77.77ab	30.61bc	4bc	4b	43.23	6.70ab	3.60	1000.0abc
D2 (2plt/hill)	39b	138.30a	78.13ab	36.27bc	5b	4b	43.22	6.12ab	3.43	1166.67a
D3 (3 plt/hill)	39b	143.03a	92.52a	52.69a	6a	5a	40.47	5.87bc	3.50	1283.33a
Pd3(30cmx30cm) D1 (1plt/hill)	40ab	120.05b	62.97bc	30.93bc	3c	3b	40.99	6.38ab	3.36	533.33bcd
D2 (2plt/hill)	40ab	117.05b	45.83cd	26.94bc	3c	3b	42.14	4.51d	2.57	300.00d
D3 (3 plt/hill)	41a	114.02b	44.45d	24.72c	4bc	4b	91.22	4.10d	1.99	466.67cd

Legend: DPPI – Days from planting to panicle initiation
PH - plant height
AM - Aboveground biomass
UM - Underground biomass
NTH - Number of tillers per hill
NPH - Number of panicle per hill
PL - Panicle length
WPH - Weight of panicle per hill
WGP - Weight of grains per panicle
GY - Grain yield per plot

Although, it was noted that the number of days from planting to panicle initiation, the interaction between Pd1D1(1 plant/hill per 20 cm x 20cm), Pd1D2 (2plants/hill per 20 cm x 20 cm), Pd1D3 (3plants/hill per 20 cm x 20 cm), Pd2D1 (1plant/hill per 25 cm x 25 cm), Pd2D2 (2plants/hill per 25 cm x 25 cm) and Pd2D3 (3plants/hill per 25cm x 25cm) was significantly affected. The wider planting distance Pd3 (30 cm x30cm) and the most number of plants per hill (3plants/hill) had the fewer number of days required among the other possible treatment combination. This means that regardless of plant density used in this study, still has positive response to any of the two planting distances used below 30 x 30 cm (20 cm x 20 cm and 25cm x 25 cm).

Sub-study 3. Rate and Time of Fertilizer Application

Growth and Yield Performance of Millet as Affected by the Rate of Fertilizer Application

As presented in Table 5, significant difference was observed in the rate of fertilizer application in all the growth and yield parameters gathered in the study. The rate of fertilizer application had no significant effect on the number of days from planting to panicle initiation. All the treatments had more or less similar number of days required as compared to plants without fertilizer application.

Millet plant height was significantly affected by the rate of fertilizer applied; T1, T5 and T6 had the same effect on the height of the plants. It had the highest result for plant height followed by the plant height of the plants applied with T2, T3, T4, T5 and T6. Plants without fertilizer application (To) had the lowest plant height obtained. In the number of tillers produced, plants applied with T6 had the highest number of tiller, although not sufficiently different with the plants applied with T6, T3 and T2.

There was a relationship observed on the result of the above and underground biomass. It was noticed that plants applied with T6 had the highest above and underground biomass, although the result did not significantly differed with the results on the plants applied with T1, T2, T3, T4 and T5. Panicle length and weight of grain per panicle had similar results. Regardless with what treatments applied, except with T0, the plants had more or less positive response.

The weight of panicle was higher when applied with T6 and T2 fertilizer rates, while lower results were obtained in plants applied with T5, T4, and T3 which had similar results with the plants without fertilizer application. Plants applied with T6, T5, T4, t3 and T1 had similar responses which were higher than the result of plants without fertilizer application.

For the weight of grains per panicle, no significant difference observed in all the treatments but it was noted that plants applied with T3 and T1 had higher weight of grains per panicle than the plants without fertilizer application.

No significant difference was observed on the rate of fertilizer application on the panicle length and weight of grains per hill.

Table 5. Growth and yield of millet as affected by the rate of fertilizer application.

Treatment	DPPI	PH (cm)	AM (g/hill)	UM (g/hill)	NTH	NPH	PL (cm)	WPH (g/hill)	WGP (g/panicle)	GY (g/plot)
T0 - control	52 b	60.72c	18.01c	4.23c	4.01b	2.93d	7.82b	4.31d	1.87c	208.33b
T1-60-30-30 (combination)	44 a	143.75a	96.12ab	42.62a	4.62b	5.25ab	47.70a	5.63bc	3.78a	1566.67a
T2-90-45-45 (combination)	46 a	137.85b	87.69ab	35.41ab	4.85ab	4.00c	47.55a	6.49ab	3.27b	1391.67a
T3-120-60-60 (combination)	46a	137.84b	90.0ab	38.02ab	4.93ab	4.62bc	49.47a	4.4d	3.46ab	1400.00a
T4-60-30-30 (inorganic)	44a	135.82b	85.64b	33.04ab	4.50b	4.32c	48.57a	5.60cd	2.84b	1158.33a
T5-90-45-45 (inorganic)	44a	138.88ab	90.03ab	29.96b	4.63b	4.70bc	49.48a	5.11cd	3.55a	1241.67a
T6-120-60-60 (inorganic)	46a	140.14ab	104.09a	42.64a	6.23a	5.53a	49.73a	7.34a	3.83a	1658.33a

Legend: DPPI – Days from planting to panicle initiation
PH - plant height
AM - Aboveground biomass
UM - Underground biomass
NTH - Number of tillers per hill
NPH - Number of panicle per hill
PL - Panicle length
WPH - Weight of panicle per hill
WGP - Weight of grains per panicle
GY - Grain yield per plot

The rate of fertilizer application had no significant effect on the number of days from planting to panicle initiation. All the treatments had more or less similar number of days required as compared to plants without fertilizer which need more number of days required to panicle initiation. Millet plant height was significantly affected by the rate of fertilizer applied. T1, T5 and T6 had the same effect on the plant height, also it had the highest result in terms of plant height, followed by the plant height of the millet plants applied with T2, T3, T4 T5 and T6. Plants without fertilizer application (T0) had the lowest plant height obtained.

Growth and Yield Performance of Millet as Affected by the Time of Fertilizer Application

As presented in Table 6, underground biomass and weight of grain per panicle were significantly affected by the time of fertilizer application. Plants applied with fertilizer at 30 days after planting (DAP) had higher underground biomass and weight of grain per panicle than plants applied with fertilizer at 45 DAP. Although, no significant differences were observed in fertilizer application to number of days from planting to panicle initiation, plant height, number of tillers, number of panicles, panicle length, weigh of panicle per hill and grain yield, still slight difference

was noted. It was recommended by http://inbbock.tamm.edu/othercrops/doc/umsumilletprodn.htm. that for best millet grain yield, fertilizer application should be done at planting or a day before sowing.

Table 6. Growth and yield of millet as affected by the time of fertilizer application

Treatment	DPPI	PH (cm)	AM (g/hill)	UM (g/hill)	NTH	NPH	PL (cm)	WPH (g/hill)	WGP (g/panicle)	GY (g/plot)
30 DAP	46.00	129.19	82.70	36.47a	5.00	4.00	44.08	5.68	3.39b	1297.62
45 DAP	46.00	126.65	88.63	27.72b	5.00	4.00	44.59	5.43	4.42a	1166.67

Legend: DPPI – Days from planting to panicle initiation
PH - plant height
AM - Aboveground biomass
UM - Underground biomass
NTH - Number of tillers per hill
DAP - Days after planting
NPH - Number of panicle per hill
PL - Panicle length
WPH - Weight of panicle per hill
WGP - Weight of grains per panicle
GY - Grain yield per plot

Growth and Yield Performance of Millet as Affected by the Rate and Time of Fertilizer Application

Significant differences were observed between the interaction effect of rate and time of fertilizer application to the growth and yield of millet, as presented in Table 7.

Plants applied with T3, T4, and T5 at 30 DAP required lesser number of days from planting to panicle initiation. Similar response to plants applied with T1 and T5 at 45 DAP. While plants applied with T1, T3, T4 and T6 at 30 DAP and plants applied with T2, T5 and T6 at 45 DAP had similar results and had gained the tallest plant height as compared to the plants applied with T1 at 45DAP that had more or less similar heights with plants without fertilizer application (T0).

There was a relationship on the result on the above and underground biomass. Plants applied with T1, T2, T3, T4 and T6 at 30 DAP and plants applied with T1, T2, T5, and T6 at 45 DAP had higher aboveground biomass as well as underground biomass. There was a huge difference observed between the plants never applied with fertilizer.

Plants applied with T2, T3, T4 and T6 at 30DAP had similar response in terms of number of tillers per hill with the plants applied with T1, T2, T5 and T6 at 45DAP. But it was also noted that the response regardless of DAP and rate of fertilizer application, only slight difference was observe with the final results of the plant without fertilizer application.

Table 7. Growth and yield of millet as affected by the rate and time of fertilizer application.

Treatment	DPPI	PH (cm)	AM (g/hill)	UM (g/hill)	NTH	NPH	PL (cm)	WPH (g/hill)	WGP (g/panicle)	GY (g/plot)
30DAP T0 –control	53c	64.47e	14.81e	3.17e	3.77b	1.7e	15.90d	1.9f	.96e	200c
T1-60-30-30 (combination)	45bc	141.5ab	91.1abcd	40.4abc	4.4b	4.2cd	47.6ab	6.67bc	2.8d	1466ab
T2-90-45-45 (combination)	46bc	136.9b	88.7abcd	40.9abc	4.9ab	4.9bc	47.5b	6.0bcde	2.8d	1533ab
T3-120-60-60 (combination)	44a	140.1ab	98.9abc	46.8a	5.4ab	5.63b	49.5ab	5.3de	4.7b	1583ab
T4-60-30-30 (inorganic)	43a	143.5ab	100.6abc	45.6a	4.8ab	4.4cd	50.2ab	6.3bcd	3.4cd	1383ab

T5-90-45-45 (inorganic)	44a	135.2bc	75.7cd	29.7cd	4.3b	3.6d	50.0ab	6.7bc	3.2cd	1357 ab
T6-120-60-60 (inorganic)	45bc	142.2ab	109.1a	48.8a	5.6ab	7.3a	47.9ab	6.92b	5.9a	1550ab
45 DAP T0 –control	50bc	56.9e	21.3e	5.3e	4.4b	1.9e	19.7c	1.9f	1.0e	216c
T1-60-30-30 (combination)	44a	146.08e	101.1ab	44.8ab	4.8ab	4.4cd	47.8ab	5.8bcde	3.1d	1666ab
T2-90-45-45 (combination)	46bc	139.7ab	86.6abcd	30.0bcd	4.8ab	4.2cd	47.6ab	5.4de	2.6d	1125ab
T-120-60-60 (combination)	47bc	135.3bc	81.0cd	29.2cd	4.4b	5.7b	49.4ab	5.4cde	3.9c	1216ab
T4-60-30-30 (inorganic)	45bc	128.1c	70.7d	20.5d	4.2b	3.7d	49.0b	4.8e	3.2d	933b

Legend: DPPI – Days from planting to panicle initiation
PH - plant height
AM - Aboveground biomass
UM - Underground biomass
NTH - Number of tillers per hill
DAP - Days after planting
NPH - Number of panicle per hill
PL - Panicle length
WPH - Weight of panicle per hill
WGP - Weight of grains per panicle
GY - Grain yield per plot

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Based on the results of the study, the following conclusions can be drawn:

1. Growth and yield performance of millet per hill is higher when seeds are sown by dropping into holes method but the grain yield is not affected by the different methods of seeding used.

2. Using closer planting distance and high plant density in millet production generally improves the growth and yield performance of millet.

3. The growth and yield performance of millet increases when the rate of fertilizer increases while, earlier application of fertilizer increases underground biomass and grain weight per panicle.

Recommendations

Based on the findings of the study, the following are recommended:

1. Dropping seeds in rows, drilled and broadcast seeding methods can be used for mi let production.

2. Closer planting distance (<30 cm) and high plant density (3plants/hill) is recommended for millet production.

3. Fertilizer application is necessary for millet production.

4. Conduct further study by increasing plant density (> than 3), fertilizer rate and different fertilizer combination.

5. Economic analysis should be evaluated to determine which treatments are more economical, practical and acceptable to farmers.

6. Other cultural practices like land preparation, weeds, insect pests and diseases, different season of planting and water application should be done.

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