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The Response of Enset (Ensete ventricosum (Welw) Cheesman) production to Rate and Frequency of N and P Nutrients Application at Areka, in Southern Ethiopia

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Abstract

Enset is one of the major food crops supporting many people in Southern Nations, Nationalities and People's Regional State. The crop requires intensive management and high amount of nutrients; however, only limited work has been done on fertilizer requirement of the crop. An experiment was conducted to determine rate and frequency of N and P fertilizers application for enset production at Areka, Wolaita, in Southern Ethiopia. Three levels of N (46, 92 and 138 kg/ha), three levels of P (20, 40 and 60 kg/ha), two levels of frequency of application (one time and two times), and absolute control treatment were arranged in factorial experiment with randomized complete block design replicated three times. Phosphorus was applied as DAP and N was applied as Urea and DAP. Data on plant height, pseudostem height, pseudostem circumference, leaf sheath number, corm weight, central shoot, bula weight, unsqueezed and squeezed kocho were collected and analyzed. The result indicated that application of N and P nutrients increased enset production at Areka. Application of 138 kg N and 20 kg P/ha per year two times in the life of the crop gave the highest enset production in all the above parameters. Beside increasing enset production, application of 138 kg N and 20 kg P/ha per year for two consecutive years enabled the enset to mature three years earlier as compared to the farmers experience in the area, which takes five years to mature. In conclusion, application of N and P nutrients more than one time in the life of enset is important to increase its production and reduce its maturity period. Therefore, application of 138 kg N and 20 kg P/ha per year for two consecutive years is recommended for better production of enset at Areka.

Keywords: Enset, Interaction, Kocho, Maturity time

Background and justification

Enset (Ensete ventricosum) is a huge perennial herbaceous plant that grows 4-11 m in height. I t is commonly known as "false banana" for its close resemblance to the domesticated banana plant. It is Ethiopia's most important root crop, a traditional staple crop in the densely populated south and southwestern parts of Ethiopia (George, 2004). Enset grows best at altitudes above 1600 meters above sea level, not because it cannot withstand heat, but because it needs adequate moisture. According to Brandt et al. (1997), enset grows best at elevations between 2000 and 2750 mters. It is adapted to deep fertile soils and ample rain fall areas (Shank and Chernet Ertiro, 1996; Brandt et al., 1997).

Enset cultivation is among the tremendous potential of the country to withstand the rapidly increasing percentage of population portion below food poverty line. It supports more than 10 million people in the South and South-western parts of Ethiopia (George, 2004). Under usual circumstances, plants flower, fruit and die. Mostly the enset crop is cultivated for food, animal feed and conservation of natural resources. The different plant parts and the by-product of the enset plant have also various uses. Enset has multipurpose uses and nothing will be left from the plant and can be dependable source of income. Thus, farmers in enset growing areas describe the importance of enset by saying that it is everything for us: our food, cloths, beds, houses, cattle feed and plates (Brandt et al., 1997). In enset-based cultivation, enset (ensete ventricosum) traditionally ranked first in importance as cultivated food crop and it is an important staple food. It is the main food source among Gurage, Sidama and related groups. It is not only staple food, but exists side by side as a co-staple to other crops, tuber crops or cereals, among Gamo, Hadiya, Wolaita and Gedeo. Farmers say: "Enset is the enemy of hunger, and human and livestock life is impossible without it" (Admasu, 2002). The central statistical authority as cited by Admasu (2002), estimated the area cultivated with enset to be about 37, 000, 18, 000 and 13, 000 ha in Sidama, Hadiya, and North Omo (where wolaita is located), respectively.

The presence of enset in the farming system contributes significantly to the stability of the food supply by several mechanisms. Enset can: 1) be stored for long periods; 2) be harvested at any time during the year; 3) be harvested at any stage over a several year period; and 4) survive stress years that reduce other food sources.

The three major products utilized as food are commonly known as Kocho, Bulla and Amicho. Kocho is a fermented product from the scrapped parenchymatic tissue of leaf sheath and pulverized corm. Bulla is made by dehydrating the juice arising from the mixture of scrapped parenchymatic tissue of leaf sheaths, pulverized corm and granted stalk of inflorescence. Amicho is the stripped corm of younger plants of enset which is boiled and consumed in a way similar to Irish potato, sweet potato and cassava.

The prolonged time that enset takes to mature (more than five years) together with acute land shortage forced farmers in Wolaita area in to consumption of immature plants. Hence farmers were overexploiting their enset reserves thereby causing gradual losses and disappearance of the false banana as an important household food security crop. This situation could be reversed by shortening the maturity period of the crop through improving the fertility of the soil where it grows.

Although the yield of enset is higher than the yield of cereals, it is far below the yield potential due to different yield limiting factors among which soil fertility decline is the major one (Admasu, 2002). A preliminary observation on effect of different sources of fertilizers on growth of enset suckers at Areka indicated that vigorous growth was observed when P, NP, and farm yard manure (FYM) were applied. Though farmers in wolaita area grow enset crop closest to their house, where they can easily fertilize it with cow dung and house refuse, cow dung has got limitation of availability to most farmers. Therefore, the use of chemical fertilizers is important. The objective of this study was to determine the rate and frequency of NP nutrients for enset around Areka.

Methodology

The experiment was conducted on Haplic Alisols of Areka, on-station. Enset clone Halla was used for the study. Enset suckers were propagated at Areka and transplanted to the main field after one year. Three levels of N (46, 92 and 138 kg/ha), three levels of P (20, 40 and 60 kg/ha) and two levels of application time (once and twice applications) were used in factorial experiment with RCB design replicated three times. A spacing of 3 m between rows and 1.5 m between plants was used. Urea and DAP were used as sources of N, while the source of P was DAP. The fertilizers were applied around the plant during transplanting and yearly on wards as per the treatments. All the other agronomic managements (weeding, cultivation etc) were carried out properly and equally for all treatments. Plant and pseudostem heights,

pseudostem circumferance, leaf sheath number, corm weight, maturity time, bulla yield, fiber yield, un-squeezed and squeezed kocho were measured.Data of different enset parameters were collected and analyzed using SAS.

Results and Discussion

Enset production was very highly significantly ($p<0.0001$) influenced by application of fertilizer. Application of N significantly reduced the maturity time of enset (Table 1). Maturity time was decreased with increasing application of N. The shortest maturity time was recorded with application of 138 kg N /ha, whereas the longest maturity time was obtained with application of no nitrogen (control). Bulla yield was also increased due to application of N. Nitrogen also significantly increased the fiber, un-squeezed and squeezed kocho yields of enset. The highest yields were obtained from the largest N rate (138 kg N/ha), whereas the lowest yields were obtained from the non fertilized plot (control). Application of P also significantly affected the above parameters (Table 2). Phosphorus significantly reduced the maturity time of enset. The longest maturity time was attained with no P application, whereas the shortest maturity time was achieved with application of all P rates. All rates of P gave significantly higher bulla, fiber, and both squeezed and un-squeezed kocho yields as compared to the control, the highest enset yields being obtained with application of 40 kg P/ha. However, there is no significant differences in yields between application of 20 kg and 40 kg P/ha.

Frequency of fertilizer application also showed significant effect on the production of enset affecting all parameters considered (Table 3). Two times application of fertilizer (both N and P nutrients) gave significantly higher enset yields (bulla, fiber and kocho yields). It also significantly reduced the maturity time of enset. During planning, frequency of fertilizer application was designed to be applied up to three times. But all enset plants that received fertilizer were matured (flowered) after two times application of fertilizer. Because of this three times application was excluded. This indicates that around Areka area two times fertilizer application for production of enset (clone Halla) is enough and no need to go beyond this.

The interaction of N and P very highly significantly improved enset production. All parameters considered were significantly influenced by the interaction of N and P (Table 4). This is in agreement with Kelsa (1996) who indicated that application of N and P gave superior enset yield components than the non fertilized plot (control). Application of N and P significantly reduced the maturity time of enset, and increased yields. Bulla, fiber, and kocho (squeezed and un-squeezed) yields were very highly significantly increased due to application of N and P.

The interaction of N and P at all rates significantly reduced maturity time of enset. The longest (about 5 years) maturity time was obtained from the non fertilized plot, whereas the shortest maturity time (about 2 years) was obtained with two times applications of N and P at different rates. Around Areka although farmers plant enset crop near their home in order to easily access farm yard manure, due to shortage of farm yard manure, the crop takes about five years to mature (flower) as the soil fertility is very low resulted from repeated (continuous) cultivation . This is too long period to address food security problem in this densely populated area where land shortage is a serious problem. The result of the study clearly indicated that increasing the fertility of the soil is very important to significantly shorten the maturity time of enset. This is a great news to the farmers around Areka as it has a very important meaning to them to attain their food security. Since the shortage of farm land does not allow the farmers to plant a large number of enset on their farm and wait for five years, enset cultivation is very much decreased in the area. The application of fertilizer could reduced the maturity time in the area at least by half, which can give an opportunity to the crop to be considered which thereby contributes a lot to food security of the area. Its drought tolerance (Dereje, 2009) gave to enset a special place in Areka area, especially during the seasons of drought when it is difficult to grow other crops. Therefore, it is important to increase yields and shorten the maturity time of this food security crop.

Application of 138 kg N and 20 kg P/ha twice per the life cycle of the crop significantly increased all yields of enset. The highest yields of bulla (1.47t/ha/y), fiber (0.36 t/ha/y), un-squeezed kocho (43.07 t/ha/y) and squeezed kocho (29.11 t/ha/y) were obtained with twice application of 138 kg/ha N and 20 kg/ha P. Whereas, the lowest yields of bulla (0.36 t/ha/y), fiber (0.09 t/ha/y), un-squeezed kocho (13.06 t/ha/y) and squeezed kocho (8.4 t/ha/y) were obtained from the non fertilized plot. Due to twice application of 138 kg/ha N and 20 kg/ha P, the increments of enset yields as compared to the control were 408.33% for bulla, 400% for fiber, 329.78% for un-squeezed kocho, and 346.55% for squeezed kocho.

Application of N and P did not influence the soil N and P contents (Table 5). The soil analysis result indicated that the N and P contents of the soil after harvest are similar under all treatments. The N and P contents of the soil were very low and not influenced by the different amounts of fertilizers and frequency of fertilizers application, which might be attributed to uptake by the crop, leaching of N and fixation of P by the soil as the soil is acidic.

Conclusion and recommendation

Soil fertility decline not only decreases enset yields but it also delays the maturity of the crop. Therefore, increasing soil fertility, besides increasing yields, significantly shortens the maturity period of enset. As enset is a food security crop especially around Areka where land shortage is a critical problem, shortening the maturity period of enset has a great place in securing food in the area. The use of chemical fertilizers for enset production is obligatory as the use of farm yard manure is very low due to its limited availability. As the use of chemical fertilizers hastens enset maturity, it prevents consumption of immature enset that inspires famers to grow enset widely which confirms food security. Thus, to increase enset yields and hastens its maturity, twice application of 138 kg N and 20 kg P/ha throughout the life of enset is recommended for Areka area.

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Table 1.Mean of different enset parameters as influenced by application of nitrogen

No.	N (kg/ha)	Maturity time (year)	Bulla yield (t/ha/y)	Fiber yield (t/ha/y)	Unsqeezed kocho (t/ha/y)	Squeezed Kocho (t/ha/y)
1	0	4.8a	0.36c	0.09c	13.06c	8.48c
2	46	2.7b	0.83ab	0.20ab	28.05ab	18.43ab
3	92	2.4c	0.75b	0.17b	25.53b	17.30b
4	138	2.3c	0.98a	0.22a	31.92a	21.48a
	LSD at 5%	0.21	0.20	0.04	4.68	3.3
	CV, %	14.9	45.0	39.5	31.2	32.9

Table 2.Mean of different enset parameters as influenced by application of phosphorus

No.	P (kg/ha)	Maturity time (year)	Bulla yield (t/ha/y)	Fiber yield (t/ha/y)	Unsqeezed kocho (t/ha/y)	Squeezed Kocho (t/ha/y)
1	0	4.8a	0.36c	0.09b	13.06c	8.48c
2	20	2.5b	0.89ab	0.22a	29.50ab	19.88ab
3	40	2.4b	0.96a	0.20a	30.71a	20.45a
4	60	2.6b	0.71b	0.18a	25.29b	16.88b
	LSD at 5%	0.2058	0.2019	0.0415	4.6809	3.2981
	CV, %	14.9	45.0	39.5	31.2	32.9

Table 3.Mean of different enset parameters as influenced by frequency of fertilizer application

No.	Frequency	Maturity time (year)	Bulla yield (t/ha/y)	Fiber yield (t/ha/y)	Unsqeezed kocho (t/ha/y)	Squeezed Kocho (t/ha/y)
1	0	4.8a	0.36c	0.09c	13.06c	8.48c
2	1	2.6b	0.75b	0.17b	26.21b	17.4ab
3	2	2.3c	0.96a	0.23a	32.01a	21.21a
	LSD at 5%	0.21	0.20	0.04	4.68	3.30
	CV, %	14.9	45.0	39.5	31.2	32.9

Table 4.Mean of different enset parameters as influenced by the interaction of N and P application

No.	N/P (kg/ha)	Maturity time (year)	Bulla yield (t/ha/y)	Fiber yield (t/ha/y)	Un-squeezed kocho (t/ha/y)	Squeezed kocho (t/ha/y)
1	46/20 once	2.59efgh	0.68efghij	0.15efgh	25.23efgh	16.10defg
2	46/20 twice	2.24hi	0.86cdefgh	0.26bc	32.092 bcde	21.74bcd
3	46/40 once	2.34ghi	0.75defghi	0.166defgh	26.167efgh	17.22cdefg
4	46/40 twice	2.14i	1.15bc	0.23bcd	35.48abc	23.13abc
5	46/60 once	2.62bcdefg	0.78cdefghi	0.189cdefg	26.07efgh	17.71cdefg
6	46/60 twice	2.49efghi	0.75defghi	0.163defgh	26.19efgh	17.32cdefg
7	92/20 once	2.78bcde	0.69efghij	0.183defg	23.84efgh	16.21defg
8	92/20 twice	2.27ghi	1.02cde	0.21cdef	32.59bcde	21.78bcd
9	92/40 once	3.00b	0.54hij	0.13gh	20.20ghi	13.14gh
10	92/40 twice	2.31ghi	0.99cdef	0.20cdefg	31.98cde	20.35bcde
11	92/60 once	2.89bcd	0.77cdefghi	0.16defgh	28.01defg	18.24cdefg
12	92/60 twice	2.46efghi	0.92cdefg	0.23bcd	28.08defg	19.71bcde
13	138/20 once	2.546defgh	0.84cdefghi	0.22bcde	27.96defg	19.17bcdef
14	138/20 twice	2.36ghi	1.47ab	0.36a	43.07a	29.11a
15	138/40 once	2.34ghi	0.86cdefghi	0.19cdefg	27.31defg	19.47bcde
16	138/40 twice	2.12i	1.60a	0.29ab	40.84ab	28.51a
17	138/60 once	2.40fghi	0.84cdefghi	0.18defg	31.08cde	19.656bcde
18	138/60 twice	2.30ghi	0.64fghij	0.199cdefg	24.39efgh	16.18defg
19	0/0	4.81a	0.36j	0.09h	13.06i	8.48h
	LSD at 5%	0.38	0.38	0.08	8.78	6.15
	CV, %	15.66	48.38	42.05	33.76	35.36

Table 5. Effect of N and P fertilizers application on N and P contents of the soil

No.	Treatments	N, %	P, mg/kg
1	46/20 once	0.2	0.8
2	46/20 twice	0.2	0.9
3	46/40 once	0.2	0.9
4	46/40 twice	0.2	1.3
5	46/60 once	0.2	0.9
6	46/60 twice	0.16	0.8
7	92/20 once	0.2	0.8
8	92/20 twice	0.2	1.1
9	92/40 once	0.5	1
10	92/40 twice	0.2	0.8
11	92/60 once	0.2	0.8
12	92/60 twice	0.2	0.9
13	138/20 once	0.2	1.2
14	138/20 twice	0.2	0.7
15	138/40 once	0.2	0.8
16	138/40 twice	0.21	0.8
17	138/60 once	0.15	1.1
18	138/60 twice	0.2	1.1
19	0/0	0.2	1.5