Potential of Hybrid Maize Varieties for Feed and Food on Irrigated Land in Supporting Cattle Development and Food Diversification

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ABSTRACT. Development of cattle in West Nusa Tenggara, are generally constrained by the limited availability of forages, especially in the dry season I and II. Farmers in West Nusa Tenggara generally grow maize in both dry season 1 and dry season 2. The purpose of this study was to determine the extent of the potential of hybrid verities of maize for food and fodder in the irrigated land in supporting the development of cattle and food diversification. Experiment was conducted with five seeds per hole and was gradually cut at a certain times until two plants/hole remain during growth period. The experiment was conducted in farmers' fields, of West Lombok West Nusa Tenggara from May to August 2012 and was laid out using a randomized block design, with four treatments of hybrid maize varieties (Bima 2, 3, 4 and 5) and replicated six times. Cutting one plant/hole was done at 30 DAS (days after sowing), 45 and 75 DAS (young corn). Trimming leaf of two, remaining plants/hole below cob was done at 90 DAS and cutting stem of plant above cob at 100 DAS and harvest at 105 DAS. The results showed that there is no significant difference of plant height between four varieties at 30, 45 and 75 DAS. The percentage of growth was significantly different at 30 DAS where the highest percentage of growth was achieved at Bima 4 and Bima 5 by 64% and 66% respectively, and at 75 DAS for Bima 5 and Bima 4 by 65 and 73% respectively, while percentage of maize growth was no significantly different at 45, 90 and 100 DAS. The highest fresh biomass at 30 DAS was found at Bima 4 and 5 by 0.46 and 0.44 t/ha respectively, at 75 DAS was found at Bima 2 and 3 by 10.92 and 10.11 t/ha respectively, at 100 DAS (cut the stem above) was found at Bima 5 by 8.67 t/ha, whereas there was no significantly different of biomass at 45 and 90 DAS. The highest yield of young corn was achieved by Bima 5 for 26 389 young cobs which was raise an additional revenue for farmer of Rp. 5,277,857. Highest productivity was achieved by Bima 5 and Bima 4 for 8.65 t/ha and 8.05 t/ha respectively. In term of total biomass, variety of Bima 5 can feed for 2 cattle for 11 months with feeding weight of 40 kg/day/cattle. This technology may be used for developing a model of maize-cattle integration system in an irrigated land especially in NTB Indonesia.

Key words: hybrid maize, biomass, food, fodder, maize-cattle system

Introduction

West Nusa Tenggara has three priority commodities development ie. cattle, corn and seaweed, which commonly called as 'PIJAR' (sapi (beef), jagung (maize) and rumput laut (seaweed). The potential of land for development of maize in West Nusa Tenggara was about 269,000 hectares, had utilized about 55 500 hectares. This indicated that the potential of land for the development of corn in West Nusa Tenggara is still promoting (NTB Bersaing 2009).

Maize can be grown on a variety of land types. In recent years, cultivation of maize has expanded and tended to shift other crops (Bahtiar and Awaludin 2005). This probably because the price was quite stable and good market with demand is increasing for feed industry and potential high of biomass for animal feed. However, the price of maize at peak season of harvest time was always low while demand for young corn for fresh consumption has increased. People in Lombok not only consume sweet young corn, but they eat hybrid and composites maize. In addition, maize biomass was also utilized for animal fodder stock.

In meanwhile, the future development of beef cattle in West Nusa Tenggara has potential to be expanded with supported by high population, cultural and high market potential for both local and regional markets. Population of beef cattle in West Nusa Tenggara on 2009 was about 546 114 with an average growth rate was about 7.53% per year (NTB Bersaing 2009).

One obstacle in raising livestock especially in the dry season is limited forage availability. Various efforts have been made by farmers to provide fodder for the cattle such as mowing the grass in the area of irrigated land or provide rice straw (Kaharudin 2010). To grow enough fodder particularly difficult because of competition from other economic commodities.

Meanwhile, farmers typically plant corn in the dry season of I (April-July) and II (August-November) in West Nusa Tenggara. According Safrudin (2010), stover/maize biomass is mainly used to feed ruminants as a source of fiber, but its use has not yet been developed widely. In addition, Hansum and Lagaligo (2003) reported carrying capacities of free grazing in dryland was only about 0.057 to 0.075 cattle/ha/year. Finding other sources of fiber for cattle has become more important due to more scarcity of availability in future (Directorate General of Livestock Services 2010; Tawaf *et al.* 2010). For that reason, it may need to modify planting system that may accommodate food and feed for cattle. Through the innovative system, it has expected development of both commodities of corn and cattle will be integrated with each other. The purpose of this study was to determine to what extent the potential of biomass and yield of various varieties of hybrid maize for food and feed in irrigated land of West Nusa Tenggara.

Methodology

The experiment was conducted on farmers' field, in West Lombok district during June to September 2012. The site of experiment was the centre of maize area. The experiment was laid out in randomized block design with treatment four hybrid maize varieties Bima 2, Bima 3, Bima 4 and Bima 5, repeated seven times, which is a farmer as replication. Maize was planted with 5 seeds/hole at spacing size of 70 cm x 40 cm. First fertilizer of NPK Phonska (200 kg/ha was applied at 10 days after planting (DAP). Second and third fertilizers were applied at 32 and 47 DAP, respectively with a dose of 150 kg urea/ha. Weeding is done at 21 DAP, using post-growth herbicides. Pest and disease were controlled by applying carbofuran at the time of planting.

One plant in each hole was harvested for cattle feeding three times at 30 DAP, 45 DAP and 75 DAP. The remaining two plants were leave for seed production with leaves at below cobs taken at 90 DAP, and stem upper the cobs were taken at the age of 100 DAP, and harvest at 105 DAP. Variables and data collected include: plant height and biomass at 30, 45, 75 and 100 DAP, the number of young corn produced and dried grain yield. Data were analyzed using analysis of variance (ANOVA), and further analysis using by Duncan test (5%) were applied and if there is a difference between treatments.

Results and Discussion

Plant height of various hybrid maize at various biomass harvesting times is shown in Table 1. Plant height was not significantly different among the four varieties tested at 30, 45 and 75 DAP. This indicates that planting maize with five seeds per hole may not affect plant height of all hybrid varieties tested.

Percentage of plant harvested for cattle feeding at various harvesting times for hybrid maize varieties is presented in Table 2. The varieties effect on the percentage of plant harvested at 30 DAP. Bima 4 variety was the highest percentages of plant harvested compared with Bima 5 and Bima 3 although that was not significantly different except for Bima 2. This indicates that the viability of Bima 4 was higher than Bima 2. More clear indication of growth viability of maize varieties was found at 45 DAP. The highest plant harvested was found at Bima 4 variety and this was significantly different with other varieties. However, the percentages of plant harvested at 75 DAP was slightly different with previous pattern. Bima 5 variety was the highest percentages of plant harvested and this was significantly different with all varieties except for Bima 4. This indicates that Bima 4 and 5 varieties may be more adaptive with planting system of five seeds/hole than other varieties. The percentage of plant harvested at 90 and 100 DAP was not significantly different among the varieties, although the highest percentages of plant harvested was found at Bima 5 variety.

Table 1. Plant height at 30, 45, and 75 days after planting (DAP) for various hybrid maize varieties.

Varieties	Plant height (cm) 30 DAP	Plant height (cm) 45 DAP	Plant height (cm) 75 DAP
Bima 2	118.5 a	195.2 a	225.8 a
Bima 3	115.3 a	201.7 a	229.7 a
Bima 4	109.8 a	201.2 a	229.3 a
Bima 5	107.2 a	207.0 a	232.2 a

Notes: numbers followed by same alphabet in the same column indicates no significant different at 5% level

Table 2. Percentages plant harvested at 30, 45, 75, 90 and 100 DAP for various varieties of hybrid maize.

Varieties	Biomas harvested (%)				
	30 DAP	45 DAP	75 DAP	90 DAP	100 DAP
Bima 2	47.8 b	56.1 a	50.0 b	94.2 a	94.7 a
Bima 3	50.6 ab	53.9 a	52.8 b	92.2 a	92.2 a
Bima 4	66.1 a	66.1 b	65.0 ab	96.1 a	96.1 a
Bima 5	63.9 ab	51.1 a	73.9 a	97.2 a	97.2 a

Notes: numbers followed by same alphabet in the same column indicates no significant different at 5% level

Biomass harvested at various harvesting times at various varieties of hybrid maize is shown in Table 3. In general, biomass harvested pattern was similar to percentages of plant harvested (Table 2) indicating that weight of biomass harvested may depend on percentages of plant harvested. Biomass weight at 45 DAP was also reported by Hippy et al. (2006), that they found the weight of maize biomass at 45 DAP was 3.63 t/ha for Srikandi Kuning variety. This means that the weight of biomass was not only influenced by the percentage of plants harvested, but also influenced by the agronomic performance. The percentage of plants biomass for Bima 5 was lower than Bima 4 although this was not significantly different (Table 2). However, the weight of biomass harvested for Bima 5 was not significantly different with Bima 4 which may be due to Bima 5 has bigger stem and leaf width.

Influence of varieties on the weight of biomass at 75 DAP can be seen at Table 3. The highest biomass weight at 75 DAP was found at Bima 2 (10.92 t/ha) and this was significantly different with Bima 5 (7.87 t/ha). This suggests that the low population would tend to increase the fresh weight biomass, especially in the rapid growth phase of the plant period.

In general, the highest total biomass was found at Bima 2 and 5 varieties and those were significantly different with Bimas 2 and 3 varieties. This difference may be due to genetic factor maize varieties where. Bima 2 variety has a higher plant s and longer leaves, while Bima 5 variety has a bigger stems with wider leaves. Those agronomic characteristics may contribute to high biomass. Therefore, the agronomic performance of maize variety needs to be considered to produce higher biomass for feeding cattle. Base on calculation, total fresh biomass of 25.62 ton/ha can be used for 3 cattle feeding for 11.4 months assuming daily cattle feed requirements of 25 kg/head/day.

Grain yield of various hybrid maize varieties can be shown at Table 4. In general, yield of maize influenced by varieties. The highest yield was found at Bima 5 although that was not significantly different with Bima 4 variety, but this was significantly different with Bima 2 and Bima 3 varieties. This indicated that Bima 4 and Bima 5 Varieties were better performance than other 2 varieties of Bima 2 and Bima 3 in planting 5 seeds/hole. In addition, yield of this system was also compared with conventional system (two seeds/hole) with Bisi 816 variety. It showed that yield of Bima 4 and Bima 5 varieties were significantly higher than Bisi 816. Bisi 816 variety was similar yield to Bima 3 (Tabel 4). This result was similar to other researchers (Syafruddin 2010; Akil et al, 2003; Syafruddin and Saida, 2006). Akil et al (2003) reported that increased population of maize following the biomass harvesting during growth period may not reduce yield and impact that will increase the revenue of farmers from fresh biomass. This indicates that planting maize with 5 seeds/hole may be potential technology for food and feed to be developed in West Nusa Tenggara

Young maize population and various varieties of hybrid maize and additional revenue of farmer is presented in Table 5. In general, young maize population has influenced by varieties. The highest young maize was found at Bima 5 variety and this was significantly different with all varieties except for Bima 4. This indicated that the high viability of maize, the more population of young corn can be harvested. Young corn can be used for food diversification. In the Table 5 also indicates that the highest revenue of farmer in cultivating maize was found at Bima 5 variety. In general, it needed 50 kg/ha with five seeds/hole compare with two seeds/hole only need seeds of 20 kg/ha. Although the price of hybrid maize seed were more expensive than composite maize, but this extra cost can be substituted by selling young corn.

Table 3. Biomass of various maize varieties at 30,45,75,90, and 100 DAP and total biomass during growth period.

Varieties	Biomas harvested (%)					
	30 DAP	45 DAP	75 DAP	90 DAP	100 DAP	Total
Bima 2	0.255 c	2.22 b	10.92 a	4.68 a	6.98 b	25.06 a
Bima 3	0.436 ab	2.77 ab	10.11 ab	4.75 a	6.90 b	24.97 b
Bima 4	0.461 a	3.54 a	8.39 ab	5.03 a	7.26 b	24.68 b
Bima 5	0.315 bc	3.55 a	7.87 b	5.21 a	8.67 a	25.62 a

Notes: numbers followed by same alphabet in the same column indicates no significant different at 5% level

Table 4. Yield of grain maize with 5 seed/hole at various varieties compared with 2 seed/hole at West Lombok West Nusa Tenggara.

Varieties	Grain producitivity (t/ha)	
	5 seeds/hole	2 seeds/hole
Bima 2	5,97 b	-
Bima 3	7,15 c	-
Bima 4	8,05 a	-
Bima 5	8,65 a	-
Bisi 816	-	7,25

Notes: numbers followed by same alphabet in the same column indicates no significant different at 5% level

Table 5. Young corn population at various hybrid maize varieties and additional income of farmers.

Varieties	Young corn population (cobs)	Income addition (Rp)
Bima 2	17.857 b	3.571.429
Bima 3	18.850 b	3.770.000
Bima 4	23.214 ab	4.642.857
Bima 5	26.389 a	5.277.857

Notes: numbers followed by same alphabet in the same column indicates no significant different at 5% level

Conclusion

1. Fresh weight biomass are influenced by genetic factor and plant populations.
2. Varieties of Bima 5 has the best adaptability with planting system of five seeds per hole as indicated by the total biomass of 25.62 t/ha, young corn population of 26,389 cobs and grain yield of 8.65 t/ha.
3. The use of hybrid seeds for planting with 5 seeds per hole may gave additional income for farmer from selling young corn.
4. The system of planting five seeds per hole has potential innovative technology to be developed and integrated with cattle in West Nusa Tenggara Province..

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