Original Research Article **ISSN; 2411-1376**

Title: **Effect of Seed Distribution and Population on Grain Yield of Selected Maize Varieties**

Yayeh Bitew[1], Fekremariam Asargew[1], Yeshitila Merine[2], Gobezie Chakelie[1]

[1]Agronomist, Adet Agricultural Research Centre, Amhara Agricultural Research Institute, P .O. Box 08, Bahir Dare, Ethiopia

[2]Entomologist and Crop Technology Supply Directorate Director, Amhara Agricultural Research Institute, P .O. Box 527, Bahir Dare, Ethiopia

Corresponding Author:

Yayeh Bitew

Email: **yayehbitew@gmail.com**

Phone: +251-922608234

Article Statistics

Received: 22nd June 2015

Revised: 15th Aug 2015

Accepted: 06th Sep 2015

Abstract:

Study on effect of seed distribution and population on grain yield of selected maize marieties were conducted at Adet and Finoteslam research station. The experiment was conducted using simple plot design. Increasing the number of seeds per hill in the present study increased competition between plants and lowered grain yield. Planting maize in one seed per hill gave the highest grain yield at both mid and high land altitudes of north western Ethiopia. This observation recommended that further research on different maize varieties should be conducted on different number of seeds per hill in different plant spacing and population.

***Key Words*:** Maize; Seed distribution; Population; Gain yield

Site this Article:
Yayeh Bitew, Fekremariam Asargew, Yeshitila Merine, Gobezie Chakelie, Effect of Seed Distribution and Population on Grain Yield of Selected Maize Varieties, *journal de afrikana*, 2015, 2(2); 37-43.

1. Introduction:

In different agro ecologies of Ethiopia a lot of maize varieties Maize (*Zea mays* L.) has been grown. It is the 1st most important grain crop in production (7234955.1tone) and productivity (3.44 tone/ha); and the 2th grain crop in area coverage (2,114,876.1ha) after Teff in the country (CSA, 2015). It is now becoming an important cereal crop for its high productivity and diversified use. The agro climatic conditions of Amhara region are favorable for its cultivation. However, the average yield of local maize in the area is comparatively low (2.906 t/ha), whereas the newly released varieties with appropriate crop management practice have the potential to produce more than 10.0 t/ ha (CSA, 2015). The most important factors that affect yield of maize are seed placement/distribution and seed spacing (the population).

Seed spacing, a practice that determines the spatial distribution of plants, affects canopy structure, light interception, and radiation use efficiency and, consequently, biomass or grain yield (Mattera, et al., 2013). Different spatial arrangements produced by changes in row spacing can affect appropriate plant density and, therefore, resource competition relationships which are crucial in crop productivity (Mattera, et al., 2013). Most importantly, the population and distribution of plants are believed to have a profound effect on grain yield. Wadeet al., (1988) observed that the population of plants per square meter (density) and arrangement of individual plants within a square meter determine nutrient use and grain yield of maize. Extreme uneven plant distribution can reduce grain yield up to 30% (Bee et al., 2014). They added that individual plant yields were at a maximum when plants were within 0.05 to 0.07 meters of perfect equidistant spacing. However, Tollenaar et al., (2004) noted that plant spacing which results in a perfectly uniform plant distribution has no yield advantage over no equidistant plant spacing. Narrowing plant spacing can allow plants to take spatial advantage and increase resource capture and utilization (Widdicombe and Thelen, 2002; de Bruin and Pedersen, 2008). Some studies conducted do not conclude any significant yield advantage in narrowing plant spacing (Farnham, 2001). Grain yield increases with increasing plant density and then comes to a plateau at some point; above which increasing plant population is not economical. This is because, above the plant population that gives the maximum grain yield, the reduction in grain yield due to crowding stress cannot be compensated by increasing plant stands. The strongest possible effect of plant competition for nutrients and other factors is observed when

plants are growing very near to or even in contact with each other.

Plant population and row width determine light interception and consequently photosynthesis and yield (Stewart, et al., 2003). Papadopoulos and Pararajasingham (1997) noted that it is possible to manipulate plant spacing to maximize light interception in any crop. Nafziger (2006) observed that, within the normal range of crop population, the increase in crop yield from increasing plant population is related to the increase in light interception.

Moreover, crop production packages developed by Ethiopian Agricultural and rural development Bureau used two seeds per hill in plant spacing of 80cmx45cm and 80cmx40cm for the long and short maize varieties, respectively. On contrary, research areas, private and cooperative seed producers used one seed per hill in plant spacing of 75cmx30cm and 75cmx25cm, for the long and short maize varieties, respectively. This always makes confusion on our farmers, partners, stockholders and seed producers. That is why farmers have got very low maize grain yield year after year. Therefore, the objective of this study was to absorb the combined effects of distance between hills and number of seeds planted per hill on maize grain yield.

2. Materials and Methods:

An observation study on the effect of Seed Distribution and Population on Grain Yield of selected Maize varieties was conducted for one year, 2014 at Adete and Fenotselam research stations in North western Ethiopia. The Former is located between11017, N latitude and 370 43, E longitude with an altitude of 2240 m.a.s.l and the later is located between 370 16, E latitude and100 42, N longitude with an altitude of 1917 m.a.s.l. At Adete area the mean annual total rain fall is 1257mm, ranging between 860 mm and 1771 mm and the average annual temperature is ranging from 90C to 25.50C. At Finoteselam area the average monthly rain fall is ranging between 4 mm to 210 mm and the average monthly temperature is ranging from 80C to 170C (Bitew and Asargew, 2014).

The rainfall and temperature during the experimental months are presented in Figures 1 below. The chemical characteristics of the soil at Adet are: total N (%), organic carbon (%), CEC, exchangeable K, available P and PH 0.8, 2.47, 37.97, 33.29, 1.98 and 5.17, respectively. Similarly, the chemical characteristics of the soil at Finoteslam are: total N (%), organic carbon (%), organic matter (%), available P and PH 0.02, 3.57, 6.164, 1.98 and 5.17, respectively (Bitew and Asargew, 2014).

The experimental designs were simple plot with plot area 10mx10m. Two seeds per hill (farmers

practice =Extension package) and one seed per hill were planted side by side in each location. The maize varity BH540 and BH650 were used at Yilemana Denesa (Adet), and Jabitenane (Fenoteselam) areas, respectively. The distance between each plot was 2m. Data for plant height, Cob per plant, cob length, and biomass and grain yield in kg per hectare were collected from the proposed net plot size. The data was analysis by using distractive statistics (graphs).

3. Results and Discussion:

The results of this observation indicated that planting BH540 and BH660 maize varieties in the high altitude (Adet) and mid altitude (Finoteselam) areas, respectively gave the maximum grain yield when both varieties planted in one seed per hill as compared to two seed per hill. According to the recommendations of AARC (2002), large seeded maize varieties like BH660 and small seeded maize varieties like BH540 were planted in 75cmx30cm and 75cmx25cm plant spacing.

At Adet areas, BH540 gave 11.6 % of yield advantage at 75cmx25cm plant spacing planted in one seed per hill as compared to planted in two seed per hill at similar plant spacing. Similarly, at Finoteselam areas, BH6600 gave 9 % of yield advantage at 75cmx230cm plant spacing planted in one seed per hill as compared to planted in two seed per hill at similar plant spacing. Grain yield of both varieties in the respective location decreased when planted at two seeds per hill. As this seed placement/distribution per hill increased competition would be expected, and yields were indeed lower due to the excessive number of plants. The strongest possible effect of plant competition for nutrients and other factors is observed when plants are growing very near to or even in contact with each other (Bee et al., 2014). However the same author reported that, at the large plant spacing, the opposite was observed; as the number of seeds per hill increased from one to three, yield increased. This too would be expected since the wider distances between plant placements would allow for less competitive growth and development of more plants. Tollenaar, Stewart, and Deen, (2004) noted that plant spacing which results in a perfectly uniform plant distribution has no yield advantage over no equidistant plant spacing.

This finding is in line with the recommendations of research areas that recommend planting of maize in one seed per hill in plant spacing of 75cmx30cm and 75cmx25cm, for the long and short maize varieties, respectively gave better grain yield. However, this result disproves Crop production packages developed by Ethiopian

Agricultural and rural development Bureau who used two seeds per hill in plant spacing of 80cmx45cm and 80cmx40cm for the long and short maize varieties, respectively.

5. Conclusions and Research needs:

Increasing the number of seeds per hill in the present study increased competition between plants and lowered grain yield. Planting maize in one seed per hill gave the highest grain yield at both mid and high land altitudes of north western Ethiopia. However, further research on different maize varieties should be conducted on different number of seeds per hill in different plant spacing and population.

6. References:

1. AARC (Adet Agricultural Research Center) (2002). Summary of research achievements (1987-2001), Adet, Amhara, pp1-11
2. Bitew Y, Asargew F. Determination of seed rate and inter row spacing for finger millet production (*eleusine coracana* gaertn.) in north western Ethiopia. Int J Res Rev. 2014; 1(4):pp 1-7.
3. Central Statistical Agency (2015). Agricultural sample survey. 2014/2015 Volume I Report on land utilization. Statistical bulletin no. 278. May 2015, Addis Ababa.
4. de Bruin and P. Pedersen,(2008). "Effect of row spacing and seeding rate on soybean yield," *Agronomy Journal*, vol. 100, no. 3, pp. 704–710
5. Farnham,(2001). "Row spacing, plant density, and hybrid effects on corn grain yield and moisture," *Agronomy Journal*, vol. 93, no. 5, pp. 1049–1053
6. Mattera, L. A. Romero,A. L.Cuatr´ın, P. S.Cornaglia, andA.A. Grimoldi, "Yield components, (2013). Light interception and radiation use efficiency of Lucerne (*Medicago sativa* L.) in response to row spacing," *European Journal ofAgronomy*, vol. 45: 87–95,
7. Nafziger,(2006). "Inter and Intra-plant competition in corn," *Crop Management*, International Journal of Agronomy vol. 5, no. 1, 2006 pp 8
8. Papadopoulos and S. Pararajasingham,(1997). "The influence of plant spacing on light interception and use in greenhouse tomato (*Lycopersicon esculentum* Mill.): a review," *Scientia Horticulturae*, vol. 69, no. 1-2, pp. 1–29
9. Stewart, C. Costa, L. M. Dwyer, D. L. Smith, R. I. Hamilton, and B. L. Ma,(2003) "Canopy structure, light interception, and photosynthesis in maize," *Agronomy Journal*, vol. 95, no. 6, pp. 1465–1474

10. Tollenaar, G. Stewart, and W. Deen,(2004). "Within-row plant spacing variability does not affect corn yield," *agronomy Journal*, vol. 96, no. 1, pp. 275–280
11. Wade, C. P.Norris, and P. A. Walsh, (1988). "Effects of suboptimal plant density and non-uniformity in plant spacing on grain yield of rain-grown sunflower," *Australian Journal of Experimental Agriculture*, vol. 28, pp. 617–622
12. Widdicombe and K. D. Thelen,(2002). "Row width and plant density effects on corn grain production in the Northern Corn Belt," *Agronomy Journal*, vol. 94, no. 5, pp. 1020–1023.

List of Figures:

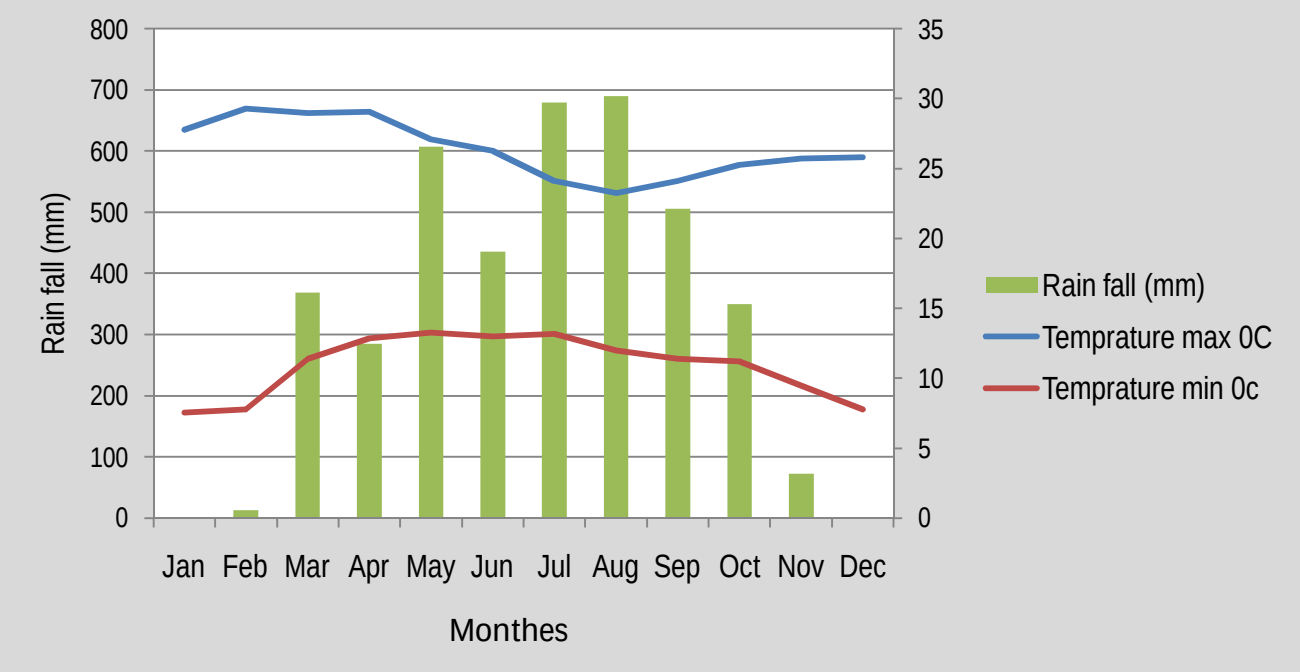

Figure 1: Mean Monthly rain fall (mm), Maximum and minimum temperature (^{o}C) during experimental months (2014). *Source, Ethiopian Metrology agency, Bahir Dar Biranch, 2014*

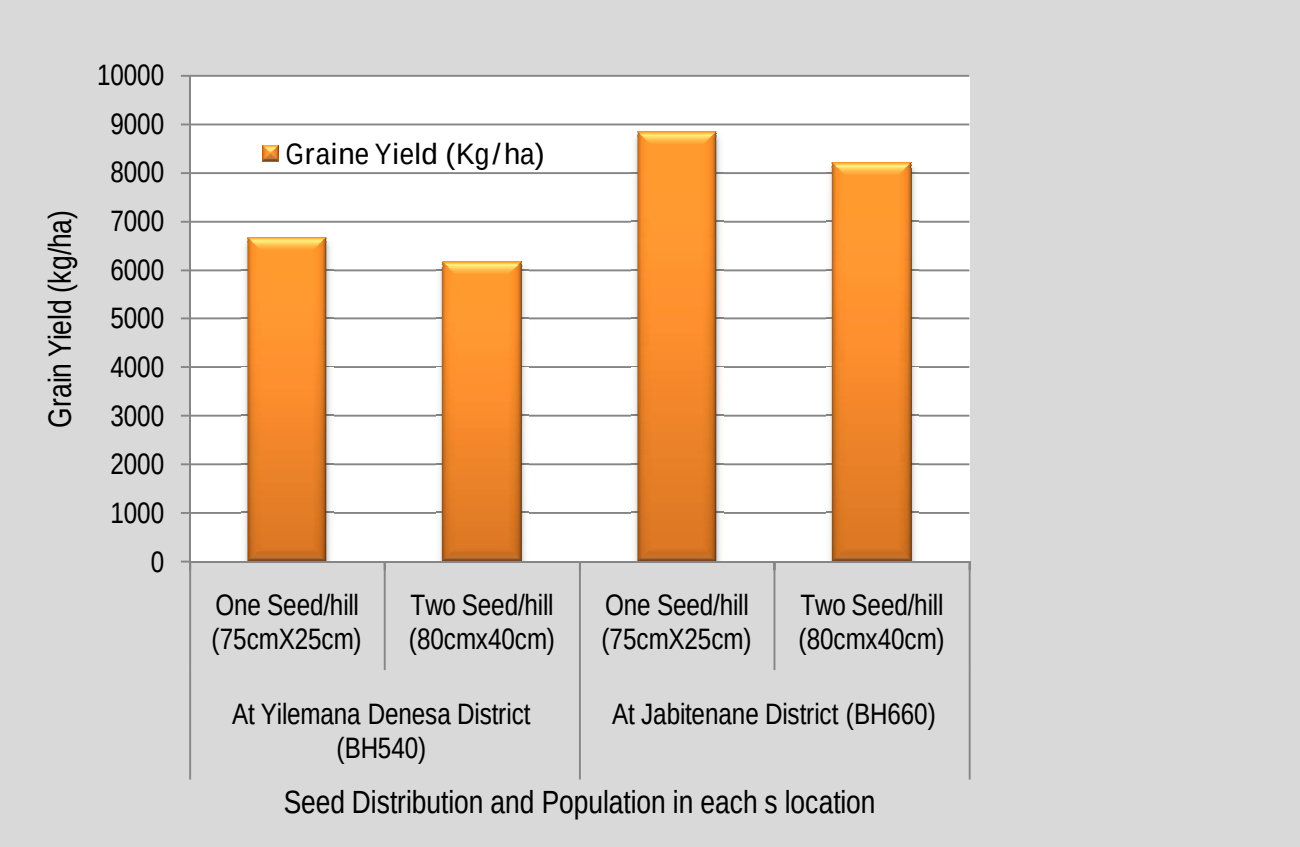

Figure 2: Effect of Seed Distribution and plant spacing/Population on Maize *(Zea mays L.)* Grain Yield