Asian Journal of Research in Crop Science

1(4): 1-4, 2018; Article no.AJRCS.41797

Influence of Age at Transplanting on the Growth and Yield Performance of Maize Transplants

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Authors' contributions

This work was carried out in collaboration between all authors. Author O. S. Olabode designed the study and wrote the protocol. Author O. S. Oladapo performed the statistical analysis and managed the analyses of the study. Author AOS wrote the first draft of the manuscript and managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJRCS/2018/41797
Editor(s):
(1) Deligios Paola Antonia, Professor, Department of Agriculture, Università Degli Studi di Sassari, Italy.
Reviewers:
(1) Habu Saleh Hamisu, National Horticultural Research Institute, Nigeria.
(2) Raul Leonel Grijalva-Contreras, Instituto Nacional de Investigaciones Forestales Agrícolas y Pecuarias, Mexico.
(3) Hakan Geren, Ege University, Turkey.
Complete Peer review History: http://www.sciencedomain.org/review-history/25171

Original Research Article

Received 28th March 2018
Accepted 3rd June 2018
Published 18th June 2018

ABSTRACT

Suboptimal plant population had been fingered as a major reason for low yield in maize production. This problem arises from poor germination due to poor seed viability caused by poor storage, unfavourable weather and field pests amongst other factors. Similarly, unstable weather had made it near impossible to predict the optimum planting date in the tropics. It has thus become very imperative to experiment with alternative methods of plant establishment for enhanced maize production in the tropics. Field experiments were conducted to evaluate transplanting as a method of field establishment for maize in Ogbomoso, South West Nigeria. The treatments; transplanting at 1 week after planting (WAP), 2 WAP and 3 WAP were compared with the control, direct seeding, in a Randomized Complete Block Design with three replications. Management practices were carried out as prescribed for standard maize production.

Result showed that transplanted maize compared significantly (P=0.05) with the direct seeded control with respect to the growth parameters. The tallest plant (2.0 m) obtained from direct sowing was not superior to one-week transplant (1.8 m) and two-week transplant (1.7 m). The largest leaf

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area (1136 cm^2) obtained from 2 WAP transplant was also not superior to 1134 cm^2, 1117 cm^2 and 1129 cm^2 from 1 WAP, 3 WAP and direct sowing, respectively. Direct sowing produced plants with thickest stem (3.2 cm) which was however not significantly (P=0.5) different from those of other treatments.

Maize yield was also not significantly (P=0.05) influenced by transplanting and age at transplanting. The higher yield (4469 kg/ha) obtained from 1 WAP transplants was not superior to 3686 kg/ha, 3515 kg/ha and 3627 kg/ha from 2 and 3 WAP transplants and direct sowing respectively. The implications of this finding in disused, it could therefore be concluded that maize production will benefit immensely from transplanting.

Keywords: Maize; age; transplanting; growth; yield.

1. INTRODUCTION

Maize (*Zea mays* L.) is an important cereal in many developed and developing countries of the world including Nigeria, where it plays a very significant role in the nutrition of both humans and livestock [1]. Aside its divergent utility, maize is very popular due to ease of production, adaptability to wide range of ecology, relatively high returns from investment and compatibility with wide varieties of cropping systems including sole cropping, mixed cropping and relay cropping [2].

A major problem of dwindling returns on investment in maize production of late had been traced to unstable weather which had made it practically difficult to correctly predict the optimum date of planting. Also, the practice of thinning which is the removal of an excess number of seedlings per stand [3] is no longer fashionable nowadays with increasing the cost of planting materials and labour bill. Besides, thinning is a wasteful exercise which should be avoided as much as possible.

In some cases, due to unfavourable weather, germination of planted seeds are unsatisfactory thus leading to reduced plant population with the attendant lower total yield. Similarly, low plant population encourages weed growth thus necessitating a higher number of weeding, resulting in increased cost of production and hence lower net income [4]. Other causes of crop failure are those of pests and diseases which are not easily controlled on the field and poor seed viability, which is a major reason why farmers may want to plant many seeds per hill to guarantee germination.

Arising from low plant population, farmers often times engage in supplying seeds on spots where the previously planted failed. This is to shore up the plant population. Supplying is laborious and hence increased the cost of production (seeds and labour costs). Besides, transplants often suffer being shaded by the older plants which eventually leads to stunted growth and consequently poor yield due to age differential.

From the foregoing, it is clear that there is the need for an alternative method of establishing maize which will guarantee optimum plant population without necessarily resorting to the wasteful and time-consuming practices of supplying and thinning. On the other hand, if supplying must be done, there is the need to ascertain that the transplant will do well by catching up with the older ones and give the good yield.

Transplanting is a practice in crop production which is defined as the transfer of previously raised healthy seedlings from the nursery to the field [5]. The benefits of this practice include those of better management of the seedlings during their vulnerable juvenile stages, reduction of mortalities that may arise from pests and diseases and elimination of the need for thinning as the number required will be transplanted per hill. Transplanting also allows shortening of the number of days the plants spend in the field especially during delayed rainfall. From an economics point of view, transplanting enables farmers to obtain produce far ahead of other farmers who depend on the steadiness of rain and thus may have better sales before the glut.

Different plant species react differently to transplanting, for example, transplanted Okra (*Abelmoschus esculentus* (L.) Moench) does not perform well in the field while a host of other crops are amenable to the practice. Thus, it is the objective of this study to evaluate transplanting as a method of establishing and supplying missing plant stands on maize plots.

2. MATERIALS AND METHODS

The field experiments were conducted at the Teaching and Research Farm of the Ladoke Akintola University of Technology, Ogbomoso

during the rainy seasons of 2015 and 2016. Ogbomoso is in the Guinea Savanna Zone of South Western Nigeria and is located on longitude 4°.10 East and latitude 8°.10 North. The soil of the site was mildly acidic (pH 6.02) and sandy loam texture (85.4% sand, 11.4% silt, 3.2% clay). Also, the soil was low in essential nutrients (0.04% total N; 4.78mgkg^{-1} available P and exchangeable bases (Cmolkg^{-1}): 0.62 K, 1.31 Ca and 0.38 Mg. The organic carbon content was 1.78%. The soil was known to be under continuous cropping of yam and cassava over previous five years. The experiment was arranged in a randomized complete block design (RCBD) with three replicates. The maize variety used was Oba Super, a local variety with yellow colouration. It is an early maturing variety (75 days).

The treatments were; transplanting at 1weeek after planting (WAP), 2 WAP and 3 WAP. The 4th treatment which was the control was direct seeding. 50 ml of water was used to irrigate each plant stand of transplants on the day of transplanting with each plant stand having two plants.

The transplant was obtained from a nursery bed on which maize was drilled the same day as the direct seeding, such that both the directly seeded seedlings and the transplant were of the same age. Twelve beds each of 3 m × 3 m dimension were made each having six rows with seven plant stands.

NPK 15-15-15 fertilizer was broadcast in the nursery while same was done for the direct seeded plants at planting. Weed was controlled using atrazine pre-emergently and one hoe weeding at five weeks after planting (5 WAP). Data were collected on plant height, leaf area and stem diameter at flowering as well as the number of days to flowering. The number of seeds per cob and weight of 100 seeds were also recorded. The total yield of maize per hectare was also estimated by extrapolation. Data were collected and subjected to analysis of variance after which significant means were separated using Duncan's Multiple Range Test (DMRT) at 5% level of probability.

3. RESULTS

The effects of transplanting age on the growth parameters of maize are presented in Table 1. Maize plant height was significantly affected by age at transplanting (p=0.05). The tallest plant was produced by direct sowing (2.0 m) which is superior only to 3 weeks old transplants (1.63 m) but similar to those of 1 WAP (1.8 m) and 2 WAP (1.69 m). Three weeks old transplants compared favourably with 1 and 2 weeks old transplants. Age at transplanting did not affect leaf area and stem diameter, which compared favourably with direct sowing (Table 1).

Table 2 presents the effects of age at transplanting on maize yield and yield parameters. Age of maize at transplanting significantly (p=0.05) affected the number of days to flowering in maize. Directly sow maize plants flowered at 53 days after planting (DAP) which is significantly earlier than all other transplants. One and two-week-old transplants flowered at the same time (58 DAP) which is significantly faster than 3 weeks old transplant (60 days). There was no significant difference (p = 0.05) amongst the treatments concerning

Table 1. Effects of transplanting age on the growth parameters of maize

Treatments	Height of plant (m)	Leaf area (cm^2)	Stem diameter (cm)
1 WAP	1.80ab	1133.81a	2.8a
2 WAP	1.69ab	1136.19a	2.75a
3 WAP	1.63b	1117.33a	2.18a
Direct sowing	2.00a	1129.48a	3.15a

Means followed by the same letter(s) are not significantly different by DMRT (p=0.05), WAP = weeks after planting

Table 2. Effects of transplanting age on the growth parameters of maize

Treatments	Days to flowering (no.)	Seeds/cob (no)	Weight of 100 seeds (g)	Estimated yield kg/ha
1 WAP	58b	543a	51a	4468.8a
2 WAP	58b	457a	51a	3685.8a
3 WAP	60a	446a	50a	3515.4a
Direct sowing	53c	453a	48a	3626.7a

Means followed by the same letter(s) are not significantly different by DMRT (p=0.05), WAP = Weeks after planting

the number of seeds/cob and weight of 100 seeds. The number of seeds per cob ranged between 446-543 seeds while the seed weight ranged from 48-51 g. The estimated yield of maize per hectare was also not significantly influenced by age at transplanting. The highest yield, (4469 kg/ha), was produced by 1-week old transplants, while the least (3515 kg/ha) was produced by 3 weeks old transplants.

4. DISCUSSION

The results from the present study corroborate the findings of previous researchers [6] and [7] who reported that grain yields of transplanted maize and those of direct seeded were not significantly different. They also reported that maize transplanted at 2 and 3 WAP produced statistically similar grain yield. This may be explained in terms of similarities in the growth parameters namely plant height, leaf area and stem diameter of both the transplanted and directly seeded maize.

The differences in the number of days to flowering exhibited by maize corroboration the report of [8] that the earlier in life the maize plant was transplanted, the earlier the flowering. This delay in flowering which however did not affect yield significantly was attributed to transplanting stock [9,10].

5. CONCLUSION

Thus from this result, it could be concluded that transplanting could be used to ensure adequate plant population when due not later than three weeks after planting. Similarly, in areas with a reliable weather forecast, this method could be used by farmers to maximize the use of the rainfall period and ensure earlier maize production thus allowing better market price before the glut.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history/25171