IJAFLS
e-ISSN: 2602-4381

International Journal of Agriculture, Forestry and Life Sciences

Original Article | Open access | Int J Agric For Life Sci (2020) 4(2): 263-267

Plug transplant age influences growth and yield of cabbage hybrids in lowland Nueva Vizcaya, Philippines

Delony A. Ugali[1*], Manolo T. Valdez[1], Aldwin D. Pablo[1]

[1]Nueva Vizcaya State University, Faculty of Agriculture, Department of Plant Science

Abstract

This study aimed to determine the response of three cabbage hybrids as influenced by different ages of plug transplant during the dry season under lowland Nueva Vizcaya conditions. The experiment was laid out in a Split Plot Randomized Complete Block Design (RCBD) with three replications. The hybrids, namely, 'Scorpio', 'Sureball F1', and 'Greenball F1', were designated as sub-plot while the ages of plug transplants, 3, 4, and 5-week old seedlings, were designated as main-plot. Results revealed that 3-week old seedlings gave the highest head length, head weight, yield per plot, computed yield per hectare, and head volume. Furthermore, 'Greenball F1' and 'Sureball F1' have the highest head length. However, 'Scorpio' formed head earlier and gave the greatest head width, highest yield per plot, and head volume. In terms of economic profitability, 'Scorpio' hybrid using a 3-week old plug transplant gave the highest economic return on expenses (ROE) of 153.93% or P1.53 for every peso invested in the production.

Key words: Age of plug transplant, cabbage, hybrid, lowland

Introduction

Cabbage (*Brassica oleracea* var. *capitata* L.) is a well-known Brassica crop belonging to the cole group, Cruciferae family. The origin of cabbage is rather obscure as it is one of the oldest vegetables grown and dates back to Ancient Greece. Locally known as repolyo, cabbages are widely grown in the Philippines.

Some of the important production practices of cabbage include the selection of the best hybrid and the ideal age of seedlings to be transplanted. These factors influence both the cost of the seedling and the seedlings' subsequent performance in the field. Adequate transplant age ensures continuous and uniform growth of plants after planting, which results in higher effectiveness and high quality of crops. It has been reported in earlier studies that suitable age of seedlings affects the yield contributing characters and consequently, on the overall yield and head quality of cabbage (Singh *et al*., 2010; Thirupal *et al.*, 2014; and Jayamanne *et al.*, 2015).

Variation in the age of seedling emergence has a large effect on the size of individual plants; in turn, this greatly influences the outcome of the subsequent competition between individuals for growth resources (Shanmugnathan and Benjamin, 1993). Hence, the aspects of crop growth need to be understood and considered when planting, since the head formation is primarily affected by the time of transplanting.

Previously, cabbage has been grown in the lowlands during the months of November to January or when the temperature is relatively cool and ideal for plant growth and development. In this research endeavor, cabbage hybrids were tested for their performance during the dry season in the lowlands using plug transplants of varying ages. The result of the study would serve as a reference on cabbage production during the dry months of December to April in Nueva Vizcaya lowlands.

Cite this artile as:
Delony A. Ugali D.A., Valdez M.T. and Pablo A.D. 2020. Plug transplant age influences growth and yield of cabbage hybrids in lowland Nueva Vizcaya, Philippines. Int. J. Agric. For. Life Sci., 4 (2): 263-267.
Received: 16.11.2020 **Accepted:** 16.12.2020 **Published:** 20.12.2020
Year: 2020 **Volume:** 4 **Issue:** 2 (December)
Available online at: http://www.ijafls.org - http://dergipark.gov.tr/ijafls

*Corresponding author e-mail: delony.ugali0915@gmail.com

Materials and methods

A two-factor experiment arranged in Split Plot- Randomized Complete Block Design (RCBD) with three replications was used in the study. The experimental area measuring 352 m^2 was divided into three equal blocks representing the replication. Each block was further subdivided into three equal plots representing the main plot which was further subdivided into three equal subplots measuring 1 x 6 m. The distance between blocks and plots was 1.0 m and 0.5 m, respectively. From these 27 sub-plots, the different treatment combinations were randomly assigned.

The experimental area was thoroughly prepared by cleaning and uprooting the weeds and other crops previously grown in the area. Alternate plowing and harrowing were done to ensure good soil tilth. The plots were constructed using a grab hoe.

'Scorpio,' 'Sureball F1,' and 'Greenball F1' cabbage seeds were sown in a seedling tray filled with vermicompost. The seedlings were grown 3, 4, and 5 weeks in a greenhouse to protect them from possible insect attack and rainfall damage. After attaining the different ages of plug transplant, seedlings were transferred to the designated area late in the afternoon to avoid transplanting shock. A total of 28 seedlings were transplanted per plot with a distance of 40 cm between hills and rows, respectively.

The seedlings were watered thoroughly right after transplanting to provide moisture and to facilitate the establishment of newly-transplanted seedlings. Succeeding irrigations were done every day, except on days when it rained and the experimental plants were able to get adequate water from the rain.

The recommended rate of 180-60-60 N, P_2O_5, K_2O kg/ha for cabbage was satisfied using 14-14-14 (Complete) and 46-0-0 (Urea). On the day of transplanting, 260g/plot of Complete fertilizer was incorporated into the soil. Meanwhile, the 157g/plot of Urea was applied during hilling up.

Hilling-up was done two weeks after transplanting using a shovel. On the other hand, weeds that grew in the experimental area were immediately removed by hand-pulling to keep the area clean and to avoid competition for nutrients, water, sunlight, and other abiotic factors affecting the growth and development of the cabbage. The experimental plants were regularly monitored for the occurrence of insect pests and diseases. Likewise, plants that show signs and symptoms of diseases were closely observed and controlled to protect other plants from getting infected.

Cabbage heads were harvested 65 days after transplanting (DAT) by cutting the head using a sharp knife, the heads were then placed in a plastic crate.

The data gathered were consolidated and tabulated using the analysis of variance (ANOVA) for Split Plot Design in Randomized Complete Block Design. The means were separated using Duncan's Multiple Range Test (DMRT) to determine the significant differences among treatment means at 0.05 level of probability.

Results and Discussion

Number of Days to Head Formation

Table 1 presents the number of days to head formation of cabbage hybrids as influenced by different ages of plug transplant. The 5-week old plug transplant formed head 4.66 and 9.27 days earlier than 4-week old and 3-week old plug transplants, respectively. This corroborates with the findings of Lewandowska (1992) that planting older transplants shortens the vegetative growth period of plants in the field and accelerates the plant's entering the phase of generative initiation that leads to the early head formation of cabbage. Moreover, McKee (1981) noted that seedlings of almost all vegetables can be transplanted in early age with little effect on growth, but with increasing age, situation changes. He also stated that the later the transplanting occurs in plant, the more serious the effect in terms of its normal development. Consequently, older plants have only a limited time for the readjustment of their vegetative development before the initiation of reproductive growth or the maturation of the vegetative phases. Also, these results may be attributed to the prevailing climatic condition of the research site as the average monthly temperature recorded during the conduct of the study ranged from 22.81^0C to 27.81^0C. This temperature range is favorable for the test crop since cabbage adapts to a wide variety of climatic conditions and can be grown best within a temperature range between 15^0C to 28^0C. Moreover, it was observed that more rainfall occurred in April when the test crops are beginning to form heads. Water supply is important for the head formation of cabbage, and the ample water supply (moisture) from rainfall facilitated the head development of the test crop. In addition, 'Scorpio' formed the head one day earlier than 'Sureball F1' and 'Greenball F1.'

Table 1. Number of days to head formation of cabbage as influenced by different ages of plug transplant

TREATMENTS	Number of days to head formation
MAIN PLOT (A)	
A1- 3 weeks	48.72a
A2- 4 weeks	44.06b
A3- 5 weeks	39.56c
C.V (%)	0.40
SUB-PLOT (B)	
B1- 'Scorpio'	43.43b
B2- 'Sureball F1'	44.44a
B3- 'Greenball F1'	44.46a
C.V (%)	0.40
A x B	
A_1B_1	47.60b
A_1B2	49.43a
A_1B3	49.13a
A_2B_1	43.53d
A_2B2	44.10c
A_2B3	44.53c
A_3B_1	39.17e
A_3B_2	39.80e
A_3B_3	39.70e

Horticultural Characteristics of Cabbage

The horticultural characteristics of cabbage as influenced by different ages of plug transplant are shown in Table 2. The 3-week old plug transplant attained the longest head of 16.70cm, followed by the 4-week old plug transplant with 15.93cm. The results indicate that older plants are exposed to greater levels of hardening and water stress even under controlled experimental conditions. Such a factor consequence in the hormonal changes that influence plant growth and leads to variances in head length of cabbage (McKee,2012). Also,

these results may be attributed to the prevailing climatic conditions of the research site receiving a sufficient amount of water throughout the head formation that led to the rapid growth and development of the test crop. Furthermore, 'Greenball F1' and 'Sureball F1' attained the longer head, measuring 16.24 cm and 16.10 cm, respectively. On the other hand, 'Scorpio' obtained the shortest head of 15.19 cm.

In addition, results show that the 3-week old and 4-week old seedlings used in transplanting were comparable to each other having a head width of 13.89cm and 13.25cm, respectively. These are significantly higher than the 5-week old seedling that measures 12.38cm. The results differed from the findings of Lamont (1992) that transplant age does not appear to significantly influence the head width and marketable quality of the crop at harvest. However, the results of the study simply denote that the younger transplants were able to establish quicker than the older seedlings since they are more prone to stress thus produced the highest head width of cabbage. Also, this may be influenced by climatic conditions. The sufficient amount of water throughout the head formation phase affected the rapid growth and development of cabbage heads. Among the hybrids, 'Scorpio' had the highest width of 14.35cm, followed by 'Sureball F1' with 12.64cm, and 'Greenball F1' with 12.54 cm.

Table 2. Horticultural characters of cabbage as influenced by different ages of plug transplant

TREATMENTS	HORTICULTURAL CHARACTERS	
	Head length (cm)	Head width (cm)
MAIN PLOT (A)		
A1- 3 weeks	16.70a	13.89a
A2- 4 weeks	15.93a	13.25a
A3- 5 weeks	14.92b	12.38b
C.V (%)	3.75	4.40
SUB-PLOT (B)		
B1- 'Scorpio'	15.19b	14.35a
B2- 'Sureball F1'	16.10a	12.64b
B3- 'Greenball F1'	16.24a	12.54b
C.V (%)	2.32	3.26

Yield and Yield Components

Table 3 shows the yield and yield components and quality characters of cabbage as influenced by different ages of plug transplant. Results revealed that the 3-week old plug transplant produced the heaviest head weight of 1,397.96g. This confirmed the findings of Bianco *et al*. (1994) that there is a linear decrease in individual head weight with increasing age of seedling used in transplanting. One possible reason for this is that older transplants are mature enough that they tend to restrain head development. Though older transplants only need minimal time in readjusting to their vegetative development or maturation of the vegetative phase, they were also subjected to more serious effects in terms of normal development; thus, they produced lower cabbage head weight. Moreover, results showed that 'Scorpio' obtained the heaviest head weight of 1,244.67g over the 'Greenball F1' and 'Sureball F1' having 1,193.71g and 1136.29g, respectively.

In addition, the 3-week old plug transplant was noted to be comparable with the 4-week old plug transplant having 32.26kg and 30.17kg harvested head per plot, respectively; however, the yields from the two transplants were found to be significantly higher than 5-week old plug transplant having only 22.13 kg. This trend was observed to be consistent with the results obtained by Lewandowska (2012) who claimed that younger transplants give higher yield. While putting the old seedlings into the field might appear to be advantageous in terms of getting the crop off to a quick start, older seedlings are also more prone to transplanting shock. Transplanting stress is found to be more severe among older seedlings likely because they lose moisture more rapidly. Furthermore, relatively young cabbage transplants produce crops that have the best stand and fastest crop development due to their ability to perform under stressful conditions with their physiological and adaptation mechanisms, resulting in the high yield of cabbages per plot. Also, 'Scorpio' attained a higher yield per plot with 29.68kg compared to 'SureballF1' and 'Greenball F1' that produced comparable total weights of harvested heads, 27.61kg and 27.25kg, respectively.

Results show that different ages of plug transplant had a highly significant effect on computed yield per hectare of cabbage. The 3-week old and 4-week old plug transplants used in the study produced comparable computed yield per hectare of 53.77 tons and 50.28 tons, respectively. These, however, were significantly higher than the 5-week old plug transplant that had 36.88 tons. These results differ from the report by Kołota *et al.* (2000) who claimed that the highest yield of cabbage was attained from the 5-week old seedling (73.45 t·ha-1), followed by the 4-week old seedling (70.73 t·ha-1), and the least yield that is significantly lower than the two seedlings is the 3-week old seedling (64.75 t·ha-1.) In this study, older seedlings are more prone to transplanting shock and are subject to more serious effects on their normal development; consequently, they produce lower computed yield per hectare. 'Scorpio' obtained the highest yield per hectare of 49.47tons followed by 'Greenball F1' and 'Sureball F1' that produced comparable yields of 27.61tons and 27.25 tons per hectare, respectively.

Quality Characters of cabbage

The 3-week old plug transplant used in cabbage production obtained the highest head volume of 2575.14cc. Meanwhile, the 4-week old was noted comparable to 5-week old plug transplant having 2202.96cc and 1807.41cc head volume, respectively. Highly significant differences were observed in the head volume as influenced by different cabbage hybrids. Among the hybrids, 'Scorpio' obtained the highest head volume of 2472.15cc, followed by 'Greanball F1' and

'Sureball F1' that produced a comparable head volume of 2057.75cc and 2055.61cc, respectively.

The head shape index was obtained by dividing mean head weight over mean head width. Highly significant differences were observed on the head shape index as influenced by the hybrid of cabbage used. 'Scorpio' had a perfect head shape index of 1.0, while ''Sureball F1' and 'Greenball F1' had 1.27 and 1.28, respectively. A head shape index of 1.0 denotes that a cabbage head is round in shape; thus, 'Scorpio' is round while 'Sureball F1' and 'Greenball F1' were oblong-shaped.

Table 3. Yield and Yield Components, Quality Characters of cabbage as influenced by different ages of plug transplant

TREATMENTS	YIELD AND YIELD COMPONENTS			QUALITY CHARACTERS	
	Head weight (g)	Yield per plot (kg)	Computed yield (t/ha)	Head volume (cc)	Head shape index
MAIN PLOT (A)					
A1- 3 weeks	1397.96a	32.26a	53.77a	2575.14a	1.20a
A2- 4 weeks	1185.94b	30.17a	50.28a	2202.96ab	1.21a
A3- 5 weeks	990.77c	22.13b	36.88b	1807.41b	1.21a
C.V (%)	10.35	13.39	14.87	14.02	1.26
SUB-PLOT (B)					
B1- 'Scorpio'	1244.67a	29.68a	49.47a	2472.15a	1.00a
B2- 'Sureball F1'	1136.29a	27.25b	45.42b	2055.61b	1.27b
B3- 'Greenball F1'	1193.71a	27.61b	46.02b	2057.75b	1.28b
C.V (%)	13.12	6.39	7.10	7.20	2.36

Economic profitability

The expenses and net returns of three cabbage hybrids using a 3-week old plug transplant were presented in Table 4. Economic computations revealed that using the 'Scorpio' hybrid has the highest economic return of 153.93% or P1.53 for every peso invested in the production. This was followed by using 'Greenball F1' with 124.75% ROE. Meanwhile, 'Sureball F1' generated the lowest ROE of 134.75% or P1.34 for every peso invested in the production.

Table 4. Production expenditures and return data of three cabbage hybrids using 3-week old plug transplant

TREATMENT	COMPUTED YIELD (t/ha)	GROSS SALES (Php	TOTAL EXPENSES (Php)	NET INCOME (Php)	ROE (%)
'Scorpio'	57.43	861400	339224	522175.79	**153.93**
'Sureball F1'	53.67	805000	342924	462075.79	**134.75**
'Greenball F1'	54.64	819650	339274	480375.79	**141.59**

Conclusion

The results of the study indicated that different ages of plug transplant show a significant impact on cabbage production during the dry season under lowland Nueva Vizcaya conditions. The 5-week old seedling of cabbage hybrids promoted earlier head formation. However, the highest head length, head weight, yield per plot, computed yield per hectare, head volume, and return on expenses was attained using the 3-week old seedlings. In terms of hybrids, 'Greenball F1' and 'Sureball F1' have the highest head length of cabbage but 'Scorpio' formed the head earlier and gave the highest head width, yield per plot, and head volume having the perfect shape index of 1.0. Moreover, results indicate that the 3-week old seedling of 'Scorpio' used in transplanting gave the highest return on expenses of 153.93% or P1.43 for every peso invested in the production.

Acknowledgments

The authors gratefully acknowledge the staff of University Central Experiment Station (UCES), Nueva Vizcaya State University, Bayombong, Nueva Vizcaya for allowing the researchers to conduct this research work at the experimental area.

Author Contributions

Ugali D. designed the study, performed the experiments, analyzed the data, and worked on the manuscript. Valdez M. and Pablo A. supervised the findings of this work and contributed to the final version of the manuscript. All authors provided critical feedback and helped shape the research, analysis, and manuscript.

Conflict of Interests

Authors declare that there is no conflict of interests

References

Bianco, V.V., Damato, G., and Girardi, A. (1994). Sowing dates, plant density, and 'crown' cutting on yield and quality of Florence fennel "seed". Acta Hortic. 362, 59-66.
https://doi.org/10.17660/ActaHortic.1994.362.6

Jayamanne, J.M., Elangeshwaran, A., Harris, K.D & Dharmasena, H. (2015). Market demand for the head size of cabbage and suitable plant spacing for downsizing it to meet the demand. Annals of Sri Lanka Department of Agriculture, 17: 144-153.

Kołota, E., and Krężel. (2009). the influence of seedlings age and pots size on growth and yielding of Chinese cabbage in spring and autumn cultivation, DOI /10.2478/v10032-009-0023-x

Lamont W. (1992). Transplant age has little effect on broccoli head weight and diameter. HortSci. 27 (7): 848 https://doi.org/10.21273/HORTSCI.27.7.848

Lewandowska, A.M (1992). The influence of transplant age on the yield of three cultivars of cauliflower in summer. Agris. 39:37-49

Mckee, J. (2012). Physiological aspects of transplanting vegetables and other crops: Factors which influence reestablishment. Hort. Abstr. 51(5):265- 272.

Murison, J. and Napier T. (2020). Cabbage growing. In: Prime Fact. Published by NSW Department of Primary Industries © State of New South Wales 2006. ISSN 1832668.

Shanmuganathan, V. and Banjamin, L. (1993). The effect of time of seedling emergence and density on the marketable yield of spring cabbage. Journal of horticultural science. 68 (6): 947-954

Singh, B., Pathak, Sarma, K. Manju Thapa. (2010). Effect of transplanting dates on plant growth, yield and quality traits of cabbage (Brassica oleracea var. capitata L.) Cultivars. Indian Journal of Hill Farming 23(2):1-5

Thirupal, D., Reddy, P., Madhumathi, C. (2014). Effect of planting dates and plant spacings on growth, yield, and quality of broccoli under Rayalaseema zone of Andhra Pradesh, India. Research Gate.