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Research Article

Evaluation of Genotypic Variation for Seed Germination, Seedling Emergence and Vigour of Cabbage Genotypes at High Altitude of Eastern Nepal

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Abstract

The experiment was conducted with five cabbage genotypes, to find out cabbage genotypes having suitable response to seed germination and vigour characteristics at Dhankuta, Nepal, during March- April of 2018. Study was conducted using Complete Randomized Design (CRD) with four replications of each treatment. Among five genotypes, CB 18002 had best response in term of germination, speed of germination, seed vigour. It was followed by genotype CB 18001. Seed vigour had positive effect on emergence of seedlings. Therefore, CB 18002 was found to be superior over other genotypes for better seed germination and seedling establishment at high altitude.

Keywords: Cabbage; Genotypes; Seed; Germination; Vigour

Introduction

Seed germination and vigour may influence the ultimate crop yield by both direct and indirect effects: altering crop density, crop duration and spatial arrangement [1]. Seed vigour is important test of physiological seed quality: emergence and seedling growth [2]. ISTA defined seed vigour as "the Sum to those properties of the seed which determine the potential level of activity and performance of the seed or seed lot during germination and seedling emergence" [3]. Cabbage is a most important winter vegetable grown all over the world. It belongs to family Brassicacea. It is the major agriculture product exported to India through Kakarbhitta customs, Jhapa, a major custom of Eastern region of Nepal. Similarly, off season cabbage is the major fresh vegetable exported from Pashupatinagar customs, Ilam [4]. Seed germination and vigour are important determinants of cabbage yield in high altitude: mild temperate region of Nepal. Quick emergence of seedlings is primary of concern to avoid the negative effect of soil and pathogen attack to seedling growth. Germination percentage estimates the maximum number of seeds that will produce normal seedlings [5]. Germination and emergence are highly affected by environmental factors. Therefore, robust high vigour seeds - that can mitigate negative impacts of environmental like excessive low temperature at high altitude- are essential to be tested [6].

Materials and Methods

The experiment was conducted during March of 2018 at Chhathar-Jorpati Rural Municipality, Dhankuta, Nepal. This locality is located at 27^0 06' N latitude and $87^0$40' E longitude with an elevation of 2150 meters above sea level. The samples of seeds of cabbage genotype were obtained from Karma Group of Companies, Nepal; genotypes were imported from Chia Tai Co. Ltd., Thailand. Seeds of all genotypes having less than 1 year age were used. The experiment was conducted in Completely Randomized Design (CRD) with five treatments and four replications of each. All total there 20 plots were established. Initially, 64 seeds were allocated per plot. Seeds were sown in plastic trays with capacity of 128 seedlings on each. Coco-peat was used as a growing media for germination of seeds. All total five cabbage genotypes were used in experiment: CB 18001, CB18002, CB 18003, Big Sun -171 and Nepal Green 777. Among these, Big Sun -171 and Nepal Green 777 are registered variety; whereas, CB 18001, CB18002 and CB 18003 are yet to be registered in Nepal. Nepal Green 777 was most commonly growing variety in Dhankuta [7] which was used as check in experiment.

Germination Percentage

Twenty five seeds of each treatment in each replication were planted for germination. The germination percent of seeds for each replication was computed as:

$$\text{Germination\%} = \frac{\text{(Number of seeds germinated)}}{\text{(Number of seeds sown)}}$$

Speed of germination

Number of emerged seedlings was counted daily from days of planting to till germination was completed or ceased. The days to germination and emergence of each replication was noted. Also, the speed of germination or emergence (X) was computed by using the following formula: [8]

$$X = \frac{\text{number of seedling emerged}}{\text{days to first count}} + \ldots\ldots +$$

$$\frac{\text{increase of seedlings emerged from previous count}}{\text{days to final count}}$$

Seed vigour index

After the determination of Root and Shoot length, seed vigour index was determined using following formula:

Vigour Index= (Mean of Root Length + Mean of Shoot Length) * Percentage of Seed Germination; [9].

Root-shoot length ratio

After 20 days of sowing, the root and shoot length of bean seedling were measured. It was done with destructive simple random sampling. Around 10 seedlings were uprooted from each replication and root and shoot length of each seedlings were measured. Then the root shoot length ratio was determined as;

$$\text{Root Shoot length ratio} = \frac{\text{root length}}{\text{shoot length}}$$

Results and Discussion

Germination Percentage and Speed of Germinatin (Emergence)

The germination percentage and speed of germination (Emergence) was found to be significantly different between cabbage genotypes. The maximum percentage of germination (98.44%) was recorded for genotype CB 18002, which is statistically at par with CB 18001 (97.66%) and Big Sun- 171 (95.31%). The least germination percentage was recorded in Nepal Green 777 (87.89%). The highest emergence (5.75) was recorded of Big Sun-171, which is statistically at par with all other genotypes except Nepal Green 777 (4.61). The highest germination percentage of CB 18002 might be due to larger seed size (90 seeds per 0.5 gm). Seed size is widely recognized measure of seed quality; larger seed have high germination, speed of germination, seedling survival and establishment [10].

Treatments	Germination Percentage	Emergence
CB 18001	97.66^{a}	5.59^{a}
CB 18002	98.44^{a}	5.66^{a}
CB 18003	92.58^{bc}	5.26^{a}
Big Sun- 171	95.31^{ab}	5.75^{a}
Nepal Green 777	87.89^{c}	4.61^{b}
Grand mean	94.38	5.37
CV (%)	3.49	6.63
SEm±	10.84	0.127
LSD	5.07	0.549
P Value	0.00432**	0.00417**

Table 1: Seed germination and emergence as influenced by genotypes of cabbage at Chhathar-Jorpati Rural Municipality, Dhankuta, Nepal, 2018.

Note: SEm ±: Standard Error of mean; CV: Coefficient of variation; LSD: Least significant difference. Means in the column with same letter (s) in superscript indicate no significant difference between treatments at 0.05 level of significance; '**' Significant at 0.01 level of Significance.

Seed vigour index

The significant difference in seed vigour index was found between cabbage genotypes under study. The highest seed vigour index was obtained.

Treatments	Seed vigour Index
CB 18001	1154.49^{a}
CB 18002	1305^{a}
CB 18003	1080.74^{bc}
Big Sun- 171	1064.49^{ab}
Nepal Green 777	808.36^{b}
Grand mean	1082.62
CV (%)	17.41
SEm±	35517.9
LSD	290.35
P Value	0.0358*

Table 2: Seed vigour as influenced by genotypes of cabbage at Chhathar-Jorpati Rural Municipality, Dhankuta, Nepal, 2018.

Note: SEm ± : Standard Error of mean; CV: Coefficient of variation; LSD: Least significant difference. Means in the column with same letter (s) in superscript indicate no significant difference between treatments at 0.05 level of significance; '*' Significant at 0.05 level of Significance.

Seedling height

No significant difference in seedling height (at 20 DAS) between genotypes was observed. The least seedling height (4.33 cm) was observed in CB 18002. This might be due to investment of energy on root development than shoot [11].

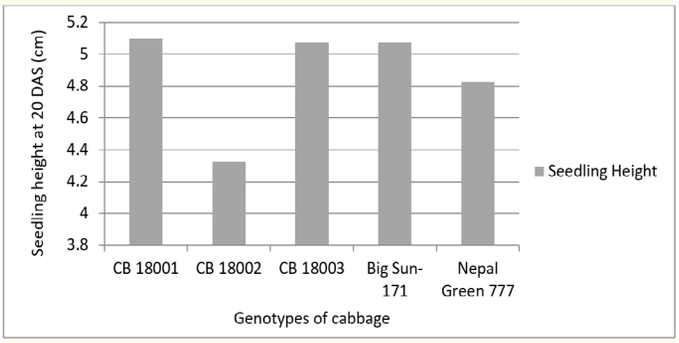

Figure 1: Seedling height of cabbage at 20 DAS at Chhathar-Jorpati Rural Municipality, Dhankuta, Nepal, 2018.

Root Shoot length ratio

The highest root shoot leangth ratio (8.97) was recorded in CB18001, which is statistically at par with all the genotypes except Nepal Green 777 (04.89). Higher root shoot ratio might be due to high investment in root tissues promoting development of root systems. Higher root leangth reach to deeper levels of substrate with more water and nutrients uptake; consequently, seedling grow profusely [11].

Treatments	Root shoot length ratio
CB 18001	5.01[b]
CB 18002	8.97[a]
CB 18003	5.87[b]
Big Sun- 171	5.58[b]
Nepal Green 777	4.89[b]
Grand mean	0.177
CV (%)	18.88
SEm±	0.001
LSD	0.051
P Value	0.0139*

Table 3: Root Shoot length ratio as influenced by genotypes of cabbage at Chhathar-Jorpati Rural Municipality, Dhankuta, Nepal, 2018.

Note: SEm±: Standard Error of mean; CV: Coefficient of variation; LSD: Least significant difference. Means in the column with same letter (s) in superscript indicate no significant difference between treatments at 0.05 level of significance; '*' Significant at 0.05 level of Significance.

Relationship between seed vigour and speed of germination (emergence)

Positive correlation was observed between speed of germination (emergence) and seed vigour. The coefficient of determination (R^2) value was 0.88. This means, as seed vigour increased, speed of germination increased.

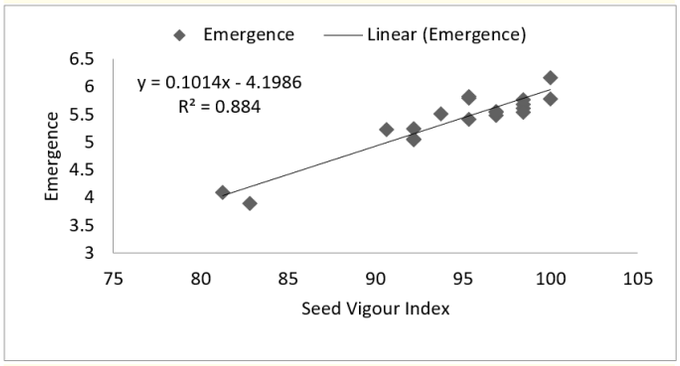

Figure 2: Relationship between seed vigour index and emergence of cabbage genotypes at Chhathar-Jorpati Rural Municipality, Dhankuta, Nepal.

Conclusion

The experiment revealed the highest germination percentage, emergence, seed vigour, and root to shoot leangth ratio of genotype CB 18002; so, it was concluded to be most suitable for high altitude of Eastern Nepal. Afer this, CB 18001 was found to be more suitable. Speed of germination was found to be positively correlated with seed vigour index.

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Bibliography

1. Ellis RH. "Seed and seedling vigour in relation to crop growth and yield". *Plant Growth Regulation* 11 (1992): 249-255.
2. Tekrony DM. "Precision is an essential component in seed vigour testing". *Seed Science and Technology* 31 (2003): 435-447.
3. ISTA. Understanding Seed Vifour. Zurich, Switzerland: The International Seed Testing Association, (1995).

4. Ojha P. "A study of vegetable and fruit export from Eastern region of Nepal". Research brief. Kathmandu: Variety Printers (2016).

5. Fessehazion., *et al*. "Predicting seedling emergence of cabbage and onion using vigour tests". *South African Journal of Plant and Soil* 25.1 (2008).

6. Finch-Savage WE and GW Bassel. "Seed vigour and crop establishment: extending performance beyond adaptation". *Journal of Experimental Botany* (2015): 1-25.

7. DADO. Annual Report. Profile. Ministry of Agriculture Development. Dhankuta, Nepal: District Agriculture Development Office, (2016).

8. Maguire J. "Speed of germination-aid in selection and evaluation for seedling emergence and vigour". *Crop Science* 2 (1962): 176-177.

9. Abdul-Baki A and J. Andersen. "Relationship between decarboxylation of glutamic acid and vigour in soyabean seed". *Crop Science* 13 (1973): 222-226.

10. Jerlin R and K Vadivelu. "Effects of fertilizer application in nursery for elite seedling production of Pungam (Pongamia pinnata L. Picrre)". *Tropical Agriculture Research and Extension* (2004): 301-308.

11. Canadell, Josep and Paul H Zedler. "Underground Structures of Woody Plants in Mediterranean Ecosystems of Australia, California, and Chile". E*cology and Biogeography of Mediterranean Ecosystems in Chile, California, and Australia* (1995): 177-210.

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