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RESEARCH ARTICLE

Seedling age, nitrogen fertilizer, and seed storage time affect the seed germination of rice varieties in Nigeria

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ABSTRACT

The aim of this study was to evaluate how seedling age and nitrogen (N) fertiliser (urea) rates affected germination of two rice types stored in storage. Seedlings that were seven days old and had not been fertilised with nitrogen had the highest germination rate. Germination declined with storage in all of the treatments, however germination improved after one and two months. Seeds held at one and two months had a non-significant greater germination when 0 kg – 60 kg N ha-1 was applied to seven-day-old rice seedlings, and this might be advised for proper seed germination in rice.

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INTRODUCTION

The germination of seeds is a critical component of agricultural output. The seed germination test is used to determine the quality of a seed lot by determining the percentage of seeds that will germinate and grow into normal seedlings over time under appropriate conditions. As a result, seed quality is critical in attaining rice varieties' full genetic potential (Finch-Savage and Bassel,2016). Some rice cultivars go dormant right after harvest, which can take anywhere from 0 to 12 weeks (Davies et al., 2015). Farmers can only conduct a germination test on seeds to determine if they are suitable for planting, so seed rates can be adjusted to the desired plant population in the field once the germination rate is determined

(Davies et al., 2015). The most visible sign of initial seed ageing is a decrease in viable seed germination, while rice production is the end consequence of its growth and development, which is dependent on seedling transplanting age. The duration of rice varieties and field circumstances influence the best age for transplanting seedlings. Seed output and quality are directly influenced by seedling transplanting age. In terms of seed quality, Durga et al. (2015) found that younger seedlings outperformed older seedlings. The state of maturity of seed at harvest time has an impact on seed germination. The germination of seed is highly influenced by the existing environmental conditions from the time a seed achieves physiological maturity until harvest; weathering could damage seed at this period. Seed quality in crops is also compromised when mature seeds are exposed to severe climatic conditions such as rainfall and temperature. Germination is regulated by seed ageing, according to Batabatanei (2015), as the germination rate and maximum germination dropped as the seeds aged. Seeds' potential vitality and performance capability deteriorate as they age as a result of the changes they go through (Ibrahim et al., 2013). According to Farhidi et al. (2014), nitrogen fertiliser applied at a rate of 165 kg ha-1 resulted in the highest seed germination % and seedling vigour index in rice. Nitrogen fertiliser applied to mother plants will result in seeds with greater vigour and germination, resulting in better seedling establishment (Farhidi et al., 2014).

The application of nitrogen fertiliser to rice fields is solely for the purpose of increasing grain output. Seed is used to establish rice fields, and many other crops are also seeded this way. To ensure optimal plant performance, uniform emergence of robust seedlings of the selected variety is required. Germination and the identification of high-performing seed batches are critical for effective rice production. Seed deterioration is affected by harvest time, climatic conditions, and seed drying, processing, and storage procedures. The most visible sign of initial seed ageing is a decrease in viable seed germination, while rice production is the end consequence of its growth and development, which is dependent on seedling transplanting age. Seed ageing has an impact on germination.

According to Raj and Bhatia (2014), seed germination of devana (Artemisia pallens) differed significantly depending on seedling transplanting age. The state of maturity of seed at harvest time has an impact on seed viability. The viability of seed is highly influenced by the current environmental circumstances from the time a seed achieves physiological maturity until harvest; weathering could destroy seed at this period. Seed quality in crops is also compromised when mature seeds are exposed to severe climatic conditions such as rainfall and temperature.

Wheat seed vigour and percentages of ultimate germination are influenced by nitrogen fertilisation, which results in a shorter mean germination time and time to 50% germination (Hossain, 2014). According to Shahzaman et al. (2017), urea fertiliser had the highest germination rate in sunflowers, followed by organic manure. Urea, an inorganic nitrogen fertiliser, produced the longest shoots and roots. They came to the conclusion that urea is the optimum fertiliser for sunflower seedling germination. Kandil et al. (2017) investigated the effect of nitrogen fertiliser on sunflower seed germination and found that differences in the final percentage of germination could be attributable to the amount of preserved matter in the endosperm and cultivar differences in seed size. A procedure that most likely involves cell division and no nutrition transfer prevents germination. The goal of this study was to see how different varieties, seedling transplanting age, and nitrogen fertiliser rates affected rice seed germination with storage.

MATERIALS AND METHODS

The relative humidity varies between 75 and 85 percent during the dry and rainy seasons. The annual rainfall at the sites is between 1,200 and 1,400 mm, with a mean temperature of between 230 and 330 degrees Celsius. As a result, each replication had a total of 20 sub-sub plots, resulting in a total of 60 plots per variety. After harvest, 3-5 kg of rice grain from each treatment was processed in airtight plastic containers at the Federal University of Technology Minna Crop Production Laboratory for eight months (January to September 2016).

The germination test was conducted under laboratory conditions in CRD. Each month from October 2016 to March 2017, 50 seeds from each treatment replicated four times and petri dishes were kept at 25 °C. Germinated seeds were counted after seven days and were expressed as a percentage of the number of seeds sown.

$$\frac{\text{Number of seeds that germinated}}{\text{Total number of seeds}} \times 100$$

RESULTS AND DISCUSSION

Effect of treatment factors on rice seed germination with storage

Variety not significant on rice seed germination with storage at Edozhigi. However, at Badeggi, FARO 44 produced more germination than FARO 52 with storage (Table 1). Germination is inhibited by a process which probably involves cell division and no transfer of nutrients. Simar results were reported by Vibhuti, et al. (2015), Islam et al. (2012), Khan et al. (2017), Kandil et al. (2017) who reported a significant effect of variety on seed germination of rice seed at the third, fourth and sixth months of storage at Edozhigi and Badeggi (Table 2).

Rice seed from seven days old seedlings gave the highest germination at third and fourth months of storage at Edozhigi and Badeggi and also at fifth month of storage at Badeggi. The 21 and 14 days old transplanted seedlings revealed the highest germination at the sixth month of storage at Edozhigi and Badeggi respectively. There was a general decline in rice seed germination with storage irrespective of seedling transplanting age.

Table 1. Effect of variety on rice seed germination (%) at Edozhigi and Badeggi

	Months of storage					
Varieties/ locations	1	2	3	4	5	6
Edozhigi						
FARO 44	90.00	90.00	57.81	50.72	47.00	37.85
FARO 52	90.00	90.00	56.78	49.96	42.80	34.76
LSD<0.05	0	1.76	8.60	4.70	5.54	4.07
Badeggi						
FARO 44	90.00	89.67[a]	65.22[a]	53.70[a]	46.09	42.71[a]
FARO 52	90.00	83.72[b]	49.87[b]	46.67[b]	45.26	37.70[b]
LSD<0.05	0	4.96	6.46	3.43	2.53	3.51

Table 2. Effect of seedling transplanting age on rice seed germination at Edozhigi and Badeggi

	Months of storage					
STA (days)/ locations	1	2	3	4	5	6
Edozhigi						
7	90.00	90.00	67.40[a]	55.91[a]	42.08	31.52[b]
14	90.00	90.00	50.88[ab]	48.77[b]	42.66	37.65[a]
21	90.00	90.00	54.04[b]	48.53[b]	50.07	38.47[a]
28	90.00	90.00	56.77[b]	48.22[b]	44.61	37.65[a]
LSD<0.05	0	1.75	7.34	6.82	5.36	4.61
Badeggi						
7	90.00	86.51	65.24[a]	55.81[a]	49.19[a]	40.27
14	90.00	85.38	62.64[a]	50.41[a]	45.40[a]	42.00
21	90.00	85.27	51.92[b]	49.47[a]	44.91[b]	38.68
28	90.00	90.00	51.92[b]	45.77[b]	43.27[b]	40.36
LSD<0.05	0	6.45	7.42	7.86	4.65	5.32

The increase in germination with seedling transplanting age up to 21 days old seedling could be due to the amount of stored product in the seed. Raj and Bhatia, (2014) reported that a significant difference was shown in seed germination of devana (*Artemisia pallens*) due to the transplanting age of the seedling. They recorded higher values from 35-day-seedling and lower values from the 25-day-seedlings. However, Singh et al. (1998) reported that younger seedlings performed better than older seedlings in seed germination. Nitrogen fertilizer rates revealed no significant effect on rice seed germination with storage at both experimental sites (Tables 3).

Table 3. Effect of nitrogen fertilizer rates on rice seed germination (%) at Badeggi and Edozhigi

	Months of storage					
NFR kg ha^{-1} /location	1	2	3	4	5	6
Badeggi						
0	90.00	88.47	63.32	51.35	45.34	40.12
60	90.00	87.90	58.19	52.33	45.51	42.59
120	90.00	87.58	56.29	49.87	43.85	38.07
180	90.00	86.50	55.94	49.03	45.94	39.14
240	90.00	83.49	55.93	49.25	47.83	41.71
LSD<0.05	0	7.83	10.20	5.41	4.00	5.54
Edozhigi						
0	90.00	90.00	62.15	51.77	48.79	34.84
60	90.00	90.00	58.35	49.35	44.66	37.05
120	90.00	90.00	51.62	51.01	46.65	37.12
180	90.00	90.00	58.76	49.42	40.87	36.13
240	90.00	90.00	55.49	50.24	44.06	36.77
LSD<0.05	0	2.78	13.58	7.43	4.32	6.43

The general decline in germination with storage irrespective of variety, seedling transplanting age and nitrogen fertilizer rate could be due to the aging of seeds. It has been reported that as seeds age, their potential vigour and performance capability are lowered as a result of the changes they undergo (Ibrahim et al 2013; Farhidi et al., 2014)). The health and germination capacity of seed is also affected by its age. Both genetics and the environment will affect how long a seed remains viable, as damage to the membrane, nucleic acids, and proteins occur over time (Fujikura and Karssen, 1995).

CONCLUSION

The germination rate of FARO 44 was higher. Seedlings transplanted at seven days old germinated better than seedlings transplanted at other ages. N fertilizer rates does not influence rice seed germination. The seven days old seedlings of both varieties germinated better with 0 kg – 60 kg N ha^{-1} application at one and two months of storage and could be recommended for optimum germination in rice.

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