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Abstract:-

Kidney bean (Phaseolus vulgaris L.) is the most ancient cultivated crops among the legumes. It is commonly used for human nutrition, animal feed and soil fertility. Seeds of two local dwarf varieties of kidney bean, B1-Local and B2-Local were subjected to different concentrations (0.1%, 0.3 %, 0.5%, 1.0% and 1.5%) of sodium azide (SA). Effects of chemical mutagen were evaluated for seed germination, plant survival, plant height, number of branch per plant; number of leaves/plant in both the varieties. The mutagen treated seeds as well as the control

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of both the varieties were planted in the experimental field following randomized block design (RBD) layout to raise the first mutant (M1) generation. Sodium azide concentration at 1.0% and above was lethal for both the varieties. Seedling survival was highly reduced in both the varieties (upto 68.75%). Seedling height, number of leaves/plant and number of branch/plant showed inter and intra varietal differential response.

Keywords:

Kidney Bean, Sodium Azide; Mutagen.

INDUCED GENETIC VARIABILITY FOR SEED GERMINATION AND OTHER YIELD PARAMETERS IN KIDNEY BEAN (PHASEOLUS VULGARIS L.).

INTRODUCTION

Legume seeds are grown and used for food in temperate and tropical areas of the world. They are considered as protein tablets. Since the pulse production in India remained almost stagnant during the last few decades, attempts are being made to augment pulse production technology so as to ensure availability of pulses presently 40g / adult / day to the tune of recommended 70 g. In this context among various members of food legumes common bean (*Phaseolus vulgaris* L.) also known as rajmash, french bean, kidney bean or field bean seems to hold promise especially in hill agriculture to meet out the challenges of under nutrition to much extent (Sood et al., 2003). Its production and productivity should be increased to meet the nutritional demand of ever increasing population. There is no possibility of further increase in cultivable area due to growing urbanization, diversification, dwindling water resources, micro-nutrient deficiencies and soil health deterioration. Therefore, the need to produce more pulses has to be met with fewer resources in a sustainable and cost effective manner. The growing demand can be met only through breaking the yield barriers and development of high yielding varieties (HYV) to increase the productivity. Lack of genetic variability is one of the components of yield barrier in self pollinated crops like common bean. There several options for breaking the yield barrier in pulses. Induced mutation is one of the options to increase the genetic variability rapidly in crops. Plant breeding requires the genetic variation of useful traits for crop improvement. To broaden the genetic base, it is essential to collect the favourable alleles from wild populations or alien species (Singh 2001). Another approach is to use mutagenesis to broaden the genetic diversity (Ahloowalia *et al*. 2004, Parry *et al*. 2009).

Mutation breeding has played a significant role in the last 90 years by releasing around more than 2,672 mutant varieties for commercial cultivation in the world .The major contribution is from cereals followed by ornamentals, legumes and oilseeds. Most of mutant varieties were released in China, India, Russia, Japan, Germany, Netherlands, USA and others. Many induced mutants were released directly as new varieties, others used as parents to derive new varieties. Nearly 400 mutant varieties have been released in oilseeds and legumes in the world, of these 110 varieties were released from India (Shu 2009).

Sodium azide (NaN3) is an excellent chemical mutagen, with high solubility in water, strong reaction with and low toxicity to biological materials as compared with alkylating compounds that are usually used for mutation induction in plants (Al-Qurainy and Khan 2009). Sodium azide has been reported to be mutagenic in several crop species. It's yields of mutations are achieved at moderate M1 sterility rates. Physiological effects of azides are weak, few chromosomal aberrations are induced, and it delays germination and growth. In keeping with the above information the research was carried out with the following objectives: to study the effect of sodium azide on seed germination and some agro-metrical traits in two local varieties of kidney beans.

MATERIALS AND METHOD

Seeds of two local dwarf varieties of kidney beans from Manipur viz., B1-Local (black colored seeds) and B2-Local (black colored seeds with white spots on it) were collected. One hundred and twenty (120) uniform, healthy seeds from each of the two varieties were taken in five treatments along with the control to develop M1 generation. The seeds were pre-soaked in distilled water for 6 hours. The pre-soaked seeds were later immersed in the sodium azide (SA) solution of different concentrations (0.1%, 0.3%, 0.5%, 1.0% and 1.5%) for 6 hours with intermittent shaking. Seeds soaked in distilled water for 12 hours served as control. After 12 hours, the seeds were washed under running tap water to remove excess mutagens that may be sticking in the seed coat. Twenty seeds from each treatment were used. 120 seeds of each variety in five treatments, each treatment consisting 20 seeds, along with the control were sown in the field. Seed germination was evaluated by counting the number of seeds emerged on eighth day from the day of sowing and expressed in percent. Survival of plants, number of branches/plant and number of leaves/plant were recorded on 40th day from the day of sowing.

RESULTS AND DISCUSSION

Observations were recorded on the effect of sodium azide in different concentrations on five important characters viz., germination, plant survival, plant height, number of branch/plant and number of leaves/plant in M1 generation. Germination, plant survival and number of branch/plant were gradually decreased with the increasing concentration of sodium azide. The data observed on germination percentage and percentage reduction in M1 generation under field condition (Figure 1) showed that although there was a general reduction in seed

Table: 1. Seed germination and reduction percentage under sodium azide treatments.

Concentration of SA (%)	Total no. of seed sown	No. of germinated seed	Germination percentage	Reduction percentage
		B1-Local		
Control	20	18	90	10
0.1	20	7	35	65
0.3	20	5	25	75
0.5	20	4	20	80
1.0	20	0	-	-
1.5	20	0	-	-
		B2-Local		
Control	20	18	90	10
0.1	20	14	70	30
0.3	20	11	55	45
0.5	20	5	25	75
1.0	20	0	-	-
1.5	20	0	-	-

germination both the varieties showed inter varietal differential response to sodium azide treatment. The maximum germination percentage in B1-Local was 35 at 0.1% SA while it was 70 with the same treatment in B2-Local. Sodium azide at 1.0% and 1.5% concentrations proved lethal for both the varieties (Table 1). Reduction in germination percentage due to application of mutagen have already been reported by many works in various crops like *Hordeum vulgare* (Pearson et al. 1975); *Pisum sativum* (Kleinhoff's 1978b); *Vigna unguicunata* (Mensah *et al*. 2005); *Nigella, Plantago* and *Trigonella* (Rajni *et al*. 2011); *Stevia rebaudiana* (Snehal and Madhukar 2012).

The effect of sodium azide on kidney beans in terms of plant survival was observed on 40th day date of sowing. Table 2 shows that treatment of sodium azide causes reduction in plant survivability though the magnitude varies in the two varieties examined. Treatment with sodium azide in all the concentrations caused 50% reduction in plant survival in B1-Local

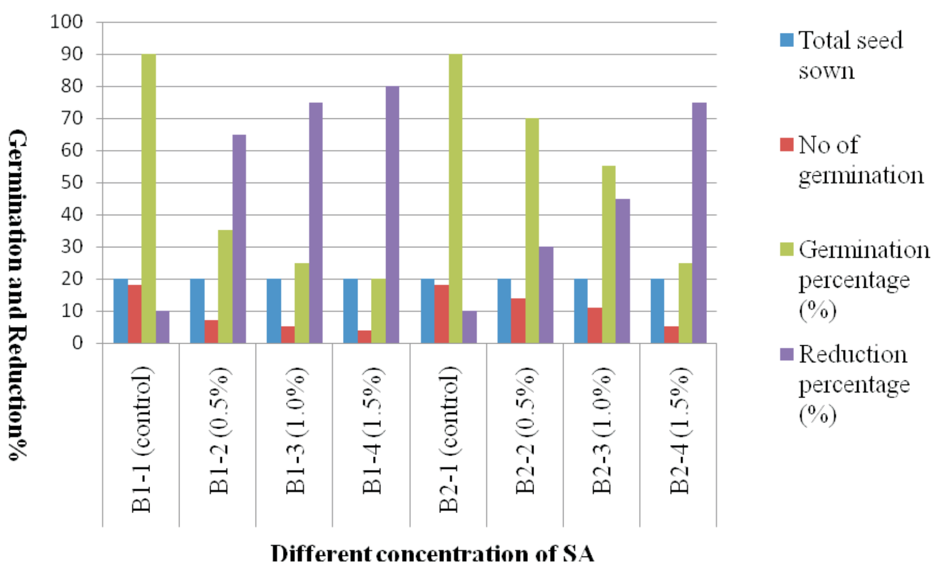

Figure: 1. Mutagenic effect of SA on seed germination and reduction in percent

Table: 2. Effect of sodium azide on some traits of kidney beans.

Characters	Treatments	Reduction (in percent)		Increment (in percent)	
		B1-Local	B2-Local	B1-Local	B2-Local
Plant height (cm)	Control	-	-	-	-
	0.1	27.05	6.41	-	-
	0.3	-	-	36.97	15.39
	0.5	-	13.43	19.75	-
Plant survival	Control	-	-	-	-
	0.1	50	52.08	-	-
	0.3	50	58.33	-	-
	0.5	50	68.75	-	-
Number of branch/plant	Control	-	-	-	-
	0.1	91.16	14.69	-	-
	0.3	-	3.80	41.34	-
	0.5	46.99	52.75	-	-
Number of leaves/plant	Control	-	-	-	-
	0.1	73.11	6.26	-	-
	0.3	-	11.61	50.72	-
	0.5	-	35.98	30.25	-

while the maximum reduction in percent (68.75%) was observed at 0.5% SA concentration in B2-Local. While 0.1% SA and 0.3% SA reduced the survival at the rate of 52.08% and 58.33% respectively in the latter variety. Similar results were reported by Srivastava *et al*. (2008) in pea, Gaibriyal *et al* 2009 in black gram and Rajni *et al*. (2011) in *Nigella, Plantago* and *Trigonella*.

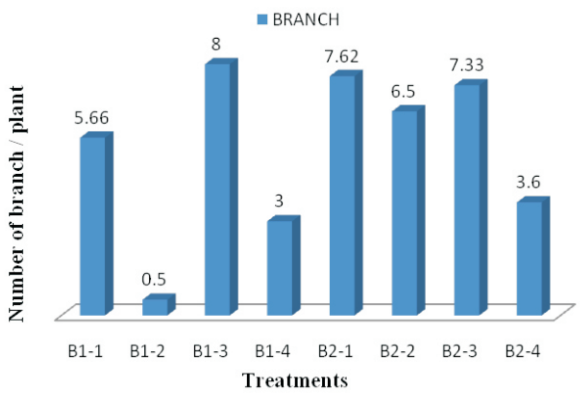

Figure: 3. Graphical representation of mean value of number of branch per plant in SA treated two local dwarf kidney bean varieties. B1-1 & B2-1 = Control; B1-2 & B2-2= 0.1% SA; B1-3 & B2-3 = 0.3%SA; B1-4 & B2-4 = 0.5% SA;

The data on number of branch per plant recorded on 40th day after sowing in the field revealed that there was a marked decrease in number of branch per plant particularly at 0.1% SA in B1-Local. The same variety exhibited 41.34% increase with 0.3% SA. While B2-Local showed decrease in number of branch per plant under all treatments in comparison to control in M1 generation (Figure 2). The maximum reduction in number of branch per plant was observed with 0.5%SA treatment while the minimum reduction was found with 0.3%SA treatment in B2-Local (Table 2). The present finding of reduction in number of branch/plant due to SA treatment were also already established in various crop plants including M1 and M2 generations of *Nigella sativa* L., *Plantago ovata* F. and *Trigonella foenum graceum* L. (Rajani et al 2011) and in M1 musk okra (Ashish et al 2011) and *Lycopersicon esculentum* L. (Adamu and Aliyu

2007). Table 2 shows that the two local varieties showed differential inter-varietal and intra varietal response to the treatment with sodium azide at different concentrations. Number of leaves/plant was significantly reduced in the variety B1-Local

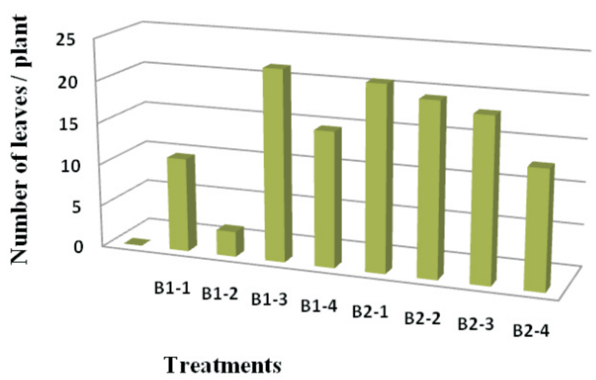

Figure: 2. Grapl ıt in SA treated two local dwarf kidney bean varieties. B1-1 & B2-1 = Control; B1-2 & B2-2 = 0.1% SA; B1-3 & B2-3 = 0.3%SA; B1-4 & B2-4 = 0.5% SA;

with 0.1% sodium azide treatment. While the same variety with 0.3% and 0.5% sodium azide treatments, the number of leaves per plant increased by 50.75% and 30.25% respectively. The variety, B2-Local exhibited a gradual decrease in number of leaves per plant with increasing dose of sodium azide concentrations (Figure 3). Ashish et al. (2011) observed increasing leaf area in musk okra due to treatment with SA. In concurrence with the observation in B2-Local, Adamu and Aliyu (2007) reported SA induced reduction in number of leaves/plant in *Lycopersicon esculentus.*

CONCLUSION

The two local dwarf kidney bean varieties were highly sensitive to higher concentration of sodium azide treatments (i.e. concentration higher than 1.0%). Sodium azide at 0.3% induced increased number of branches/plant which may be directly related to number of flowers it will bear and ultimately yield. This concentration can be used in future for inducing variability in this crop. The mutant population developed can be used for its performance in the next generations.

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