# Seed and Germination Behaviour of *Salvadora Persica* Linn (Khara Jhal, Tooth-Brush Tree, Fam: Salvadoraceae) and *Tecomella Undulata* (Sm.) Seem (Rohira; Fam: Bignoniaceae)

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## ABSTRACT
Typically, seeds are relatively dry structures as compared with other plant tissues, and in this condition, they are resistant to the ravages of time and their environment (Mitter, 1993). Characteristics of seeds, more than any other characters that the plant possess, require precise integration and co-ordination between different functions in order to have successful reproduction especially in arid zones. Seed is usually used in a functional sense, viz. as a unit of dissemination, a disseminule. In essence, seed is a miniature plant because it is responsible for its regeneration and ultimately for its reproduction success (Khurana and Singh, 2001). An angiospermic seed may appear very simple externally but possesses a complex ecophysiology for its further resumption of growth, primarily in germination. The seed is a highly dehydrated structure and is metabolically quiescent. The cotyledons serve as centres of absorption and storage, drawing nutritive material from the endosperm. The cotyledons of many plants function as primary photosynthetic organs. Each species of plant has its specific period of viability; a seed sown after the period of optimum viability may produce weak plants or may not germinate. In desert regions where rains are unpredictable and of limited duration, ephemeral plants have short life cycles and it is important for them to germinate only after a substantial fall of rain. Dormancy of seed, especially those of arid zone plants are biologically significant in spreading or delaying germination. Delayed germination is of great significance, especially in an arid zone, where the conditions are unflattering and unpleasant for normal growth and development of plants for long periods. Probably in no other habitat, a seed is subjected to such scrupulous environmental conditions as in the arid ecosystem where an acute shortage of water is a primary limitation in the germination of seeds.

***Keywords**: Unit of dissemination, Seed viability, Dormancy of seed, Delayed germination*

## A. INTRODUCTION
Seed, a term applied to the ripened ovule of a plant before germination. Seed is a fertilized ovule or a plant propagule comprising of a living embryo in which growth has been suspended, usually supplied with their own food reserves and protected by special covering layers. In essence, seed is a miniature plant because it is responsible for its regeneration and ultimately for its reproduction success (Khurana and Singh, 2001). A seed is defined as a mature ovule and also as a plant packed for mailing (Kulkarni, 2002). The seed is equipped with structural and physiological devices to fit it for its role as a dispersal unit and is well provided with food reserves, which sustain the young plant until a self-sufficient autotrophic organism is established. In nature, plants perpetuate either by seeds or by vegetative means. An angiospermic seed may appear very simple externally but possesses a complex ecophysiology for its further resumption of growth, primarily in germination. The seed is a highly dehydrated structure and is metabolically quiescent. The cotyledons of many plants function as primary photosynthetic organs. From variability studies point of view very few reports are available on the presence of genetic variability for seed traits. Each species of plant has its specific period of viability; a seed sown after the period of optimum viability may produce weak plants or may not germinate. In arid zone, probably in no other habitat, a seed is subjected to such scrupulous environmental conditions as in the arid ecosystem

where an acute shortage of water is a primary limitation in the germination of seeds.

Generally, large seeds were found to germinate faster and more completely than smaller ones and produce seedlings whose initial growth was greater since bigger seed size produces quick, uniform germination and better seedlings (Moles and Westoby, 2004), while smaller seeds should have better dispersion capabilities (Fenner, 1985). A variation in seed shape is also interpreted as adaptation. Khurana and Singh (2001) stated that various environmental factors that differ among habitats such as temperature, humidity, light, soil characteristics, dispersal syndromes, germination time, densities of competing plants, herbivore, fungi, etc. affect the production and selection of different seed sizes. So, an investigation on the various seed parameters for improving them would be useful.

In the present studies, an attempt has been made to study the seed morphology and effect of different pretreatments to enhance seed germination under laboratory conditions in, *Salvadora persica* and *Tecomella undulata* of the Indian arid zone in the year 2014-2016.

## B. Materials and Methods-

1. **Collection of seeds -** Seeds of *S. persica* and *T. undulata* were collected from three different sites nearby Churu. In *S. persica* seeds were collected from the greenish fruits and in *T. undulata* from red flowers bearing plants at all sites.
2. **Seed morphology and viability** – The morphological parameters such as seed shape, size, colour and weight were taken. The shape and colour of seeds were observed under dissecting microscope and by naked eyes. Length and thickness were measured with the help of Vernier caliper. The volumes were calculated by using water displacement method. Seed density was calculated by using the formula- Seed weight (g)/ Seed volume (ml).

The seed viability was tested by the tetrazolium method (seeds were kept in 0.1 % solution of 2, 3, 5-triphenyl tetrazolium chloride (T.T.C.) for 3-4 h in the dark) as suggested by Porter *et al*. (1947) and Mitter (1993). Viability was calculated on percentage basis. To study germination behaviour, different pretreatments such as soaking in water (soaked under running tap water for 24 h), hot water (55-60°C, pretreatment for different durations 15 and 20 min), acid scarification (scarified with 50 and 100% concentrated $H_2SO_4$ for different durations), growth regulators (seeds were soaked for 24 and 48 h in different concentrations viz. 5, 10, 25 and 50 mg $l^{-1}$ of $GA_3$, and IAA.), high temperature (50-60$^{o}$C), etc. were given to the seeds.

All parameters were taken in triplicate and confirmed twice. The results were subjected to analysis of variance (ANOVA) as suggested by Gomez and Gomez (1984).

## A. Observations

### 1. Seed morphology and viability

**Table 1 Seed morphology, weight, volume, density and viability in seeds of following plant species collected from different sites**

| Plant species | Sites | Morphological parameters | | | | Weight (g) | Seed volume (ml) | Seed density (g ml$^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| | | Colour | Shape | Size (mm) | | | | |
| | | | | Length | Breadth | | | |
| | I | Light green | Spherical | 3.1 | 3.0 | 3.62 | 2.6 | 1.39 |
| *S. persica* | II | ---do--- | --do-- | 4.5 | 3.9 | 4.15 | 2.8 | 1.48 |
| | III | Brownish green | --do-- | 3.5 | 3.2 | 3.75 | 2.6 | 1.44 |
| CD | - | - | - | 0.042* | 1.156* | 0.121* | NS | 1.662* |
| | I | Pale yellow | Winged | 18.0 | 7.0 | 0.50 | 0.9 | 0.55 |
| *T. undulata* | II | Pale brown | --do-- | 16.5 | 6.5 | 0.48 | 1.2 | 0.40 |
| | III | Dark pale brown | --do-- | 19.0 | 7.5 | 0.64 | 1.1 | 0.58 |
| CD | - | - | - | 0.027* | 2.444* | 3.092* | NS | 1.953* |

NS= Non significant; and * = Significant at 5% probability level.

**2. Seed germination behaviour**

**I. Salvadora persica**

**Fig. 1. Effect on germination by treating seeds in running water (24 h) and under control in *S. persica* collected from sites I-III.**

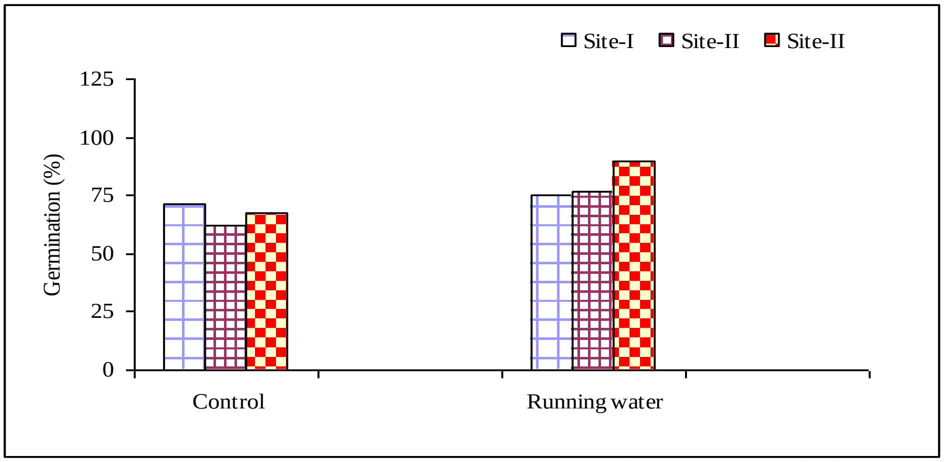



**Fig. 2. Effect of different concentrations (mg $l^{-1}$) of IAA and $GA_3$ (soaked for 24 h) on seed germination in *S. persica* collected from sites I-III.**

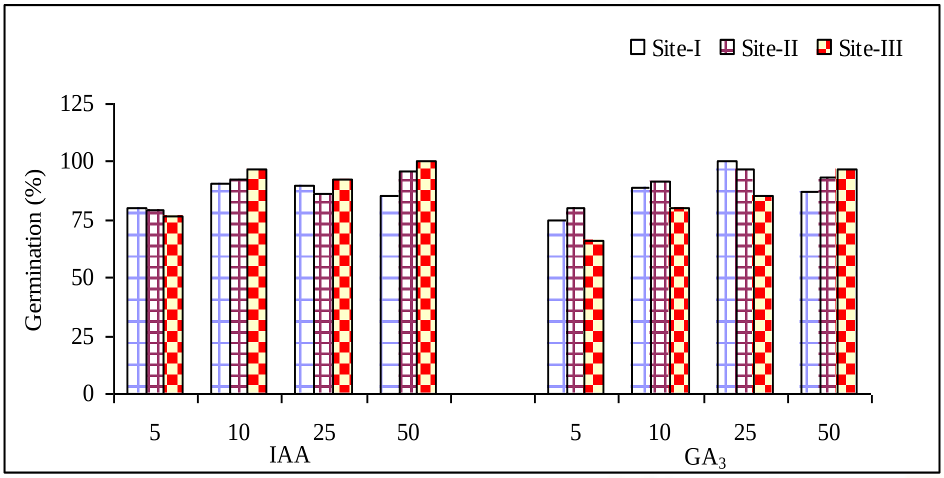



**Fig. 3. Effect of different concentrations (mg $l^{-1}$) of IAA and $GA_3$ (soaked for 48 h) on seed germination in *S. persica* collected from sites I-III.**

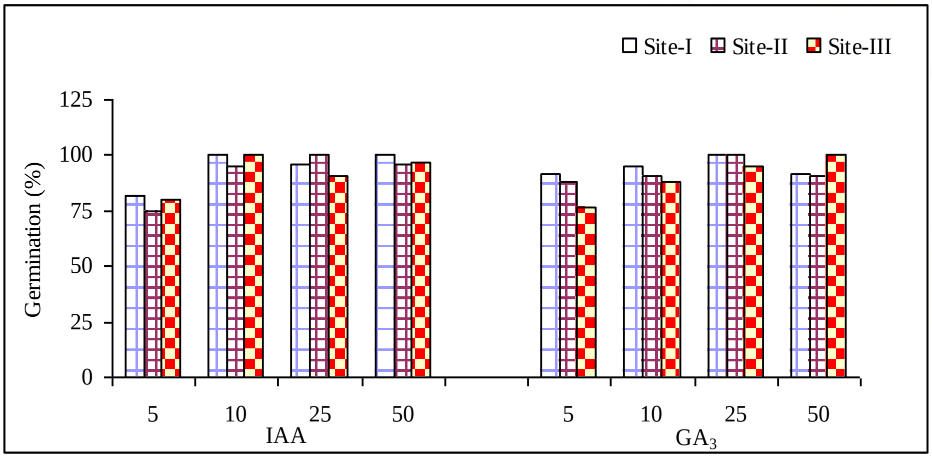


**Fig. 4. Effect of different concentrations (mg $l^{-1}$) of IAA and $GA_3$ (soaked for 24 h) on root length in *S. persica* collected from sites I-III.**

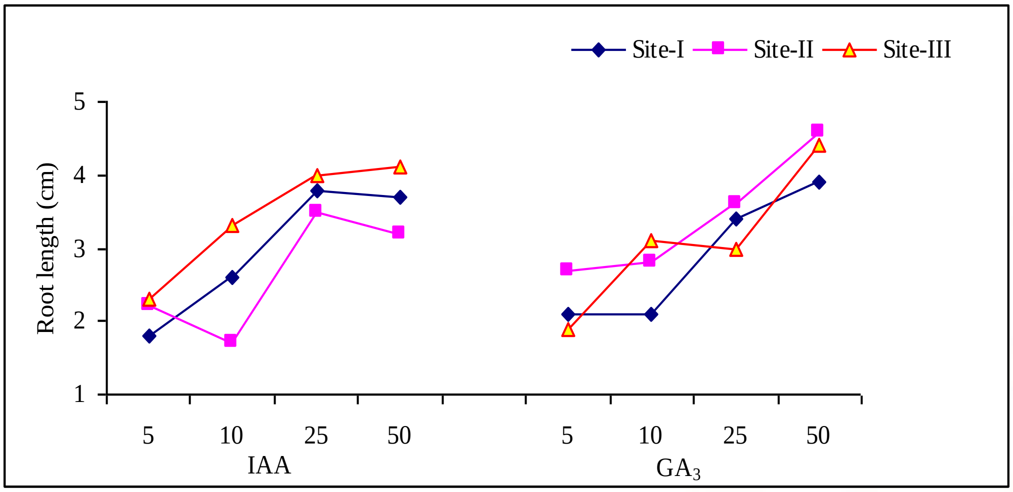



**Fig. 5. Effect of different concentrations (mg $l^{-1}$) of IAA and $GA_3$ (soaked for 48 h) on root length in *S. persica* collected from sites I-III.**

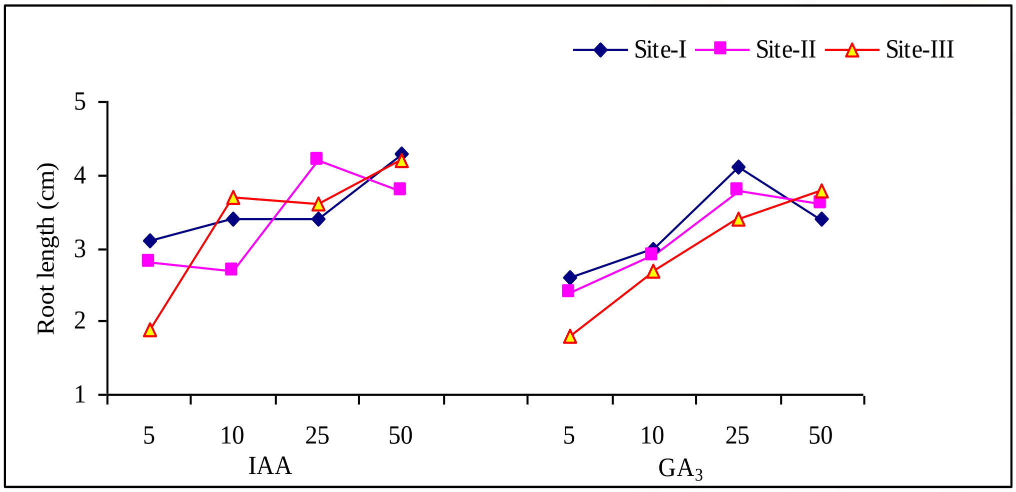



**Fig. 6. Effect of different concentrations (mg $l^{-1}$) of IAA and $GA_3$ (soaked for 24 h) on shoot length in *S. persica* collected from sites I-III.**

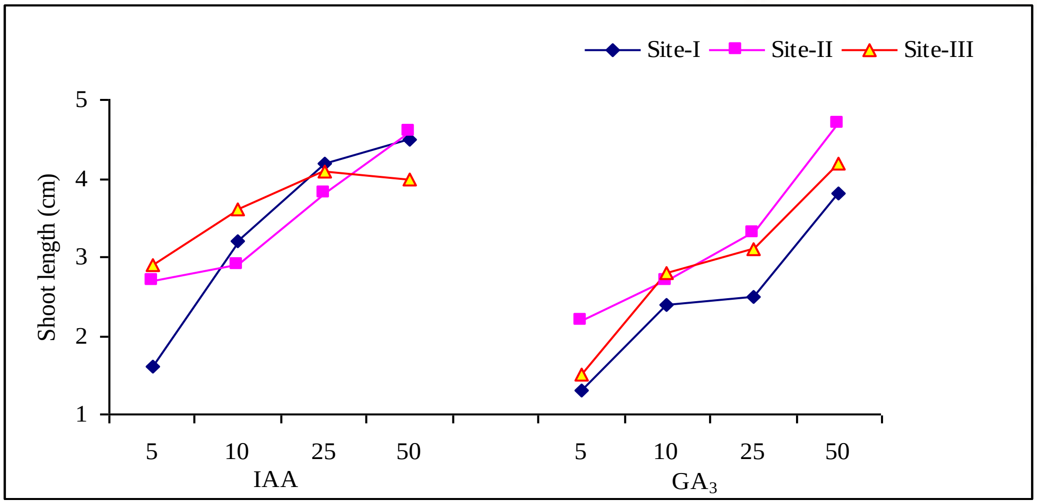
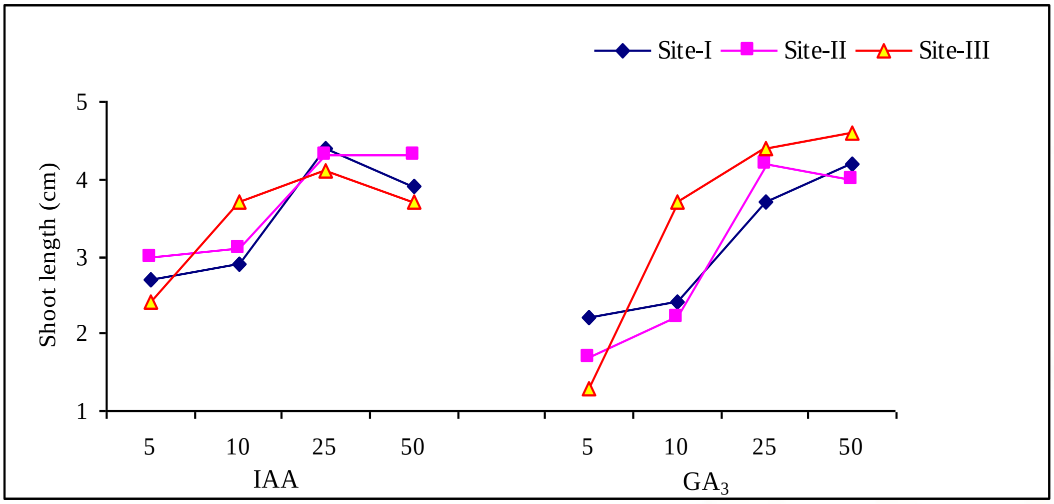


**Fig. 7. Effect of different concentrations (mg $l^{-1}$) of IAA and $GA_3$ (soaked for 48 h) on shoot length in *S. persica* collected from sites I-III.**




## II. Tecomella undulata

**Fig.8. Effect on germination by treating seeds in running water (24 h) and under control in *T. undulata* collected from sites I-III.**

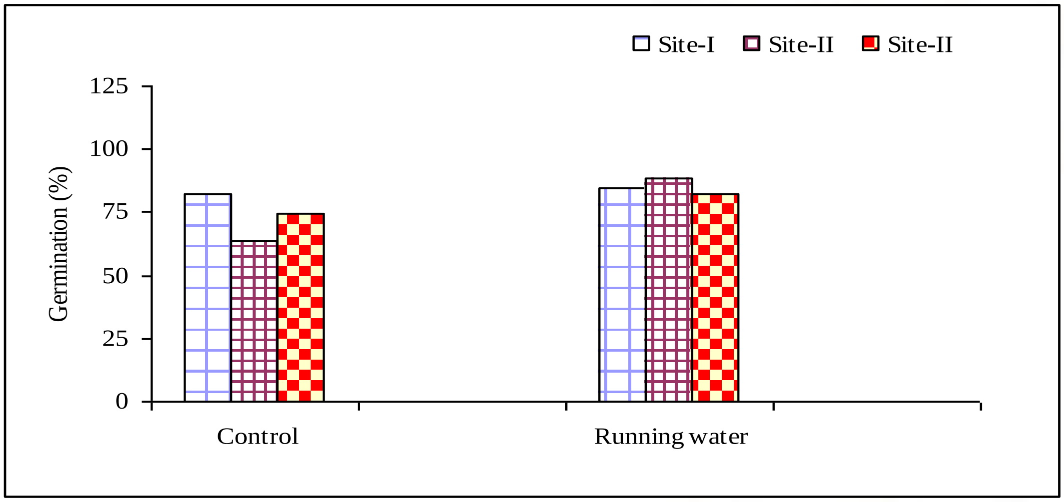



**Fig. 9. Effect of different concentrations (mg $l^{-1}$) of IAA and $GA_3$ (soaked for 24 h) on seed germination in *T. undulata* collected from sites I-III.**

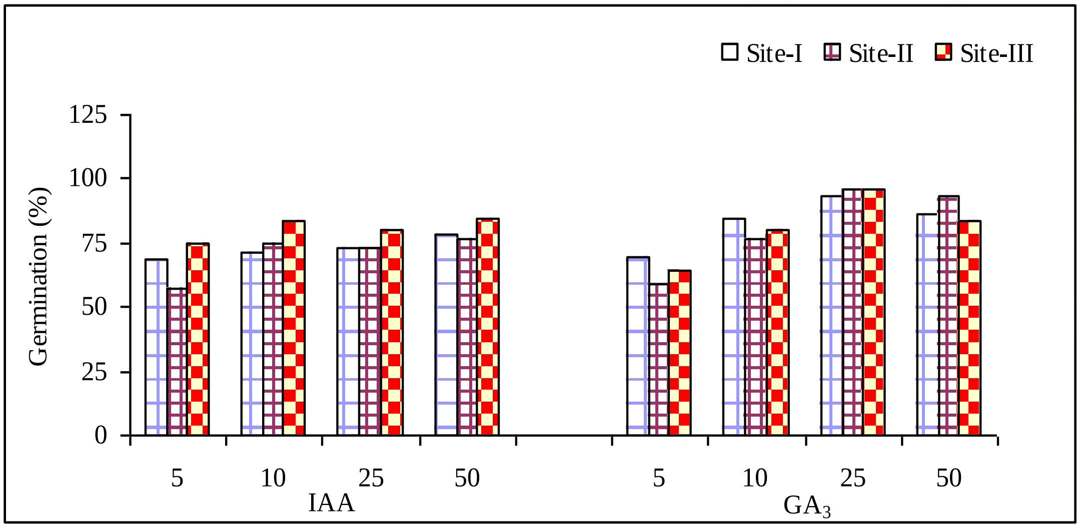


**Fig. 10. Effect of different concentrations (mg $l^{-1}$) of IAA and $GA_3$ (soaked for 48 h) on seed germination in *T. undulata* collected from sites I-III.**

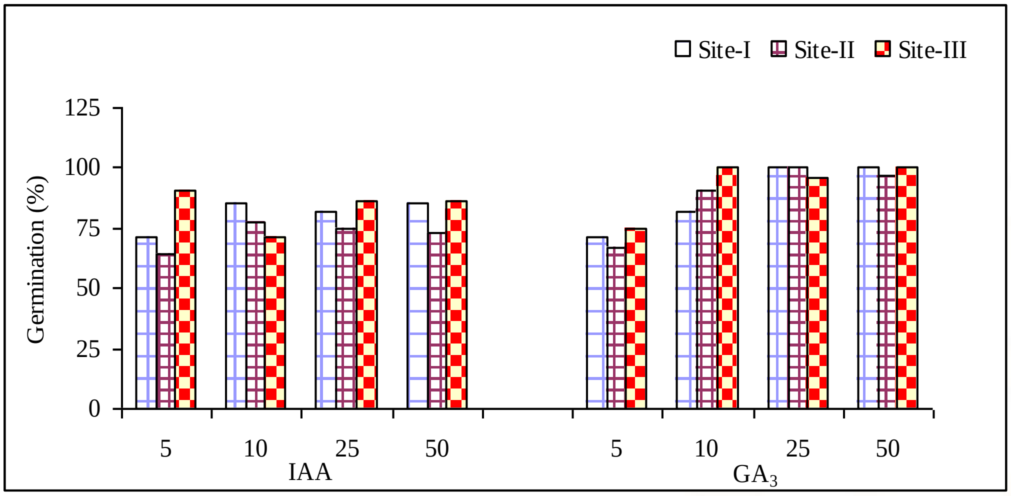



**Fig.11. Effect of different concentrations (mg $l^{-1}$) of IAA and $GA_3$ (soaked for 24 h) on root length (cm) in *T. undulata* collected from sites I-III.**

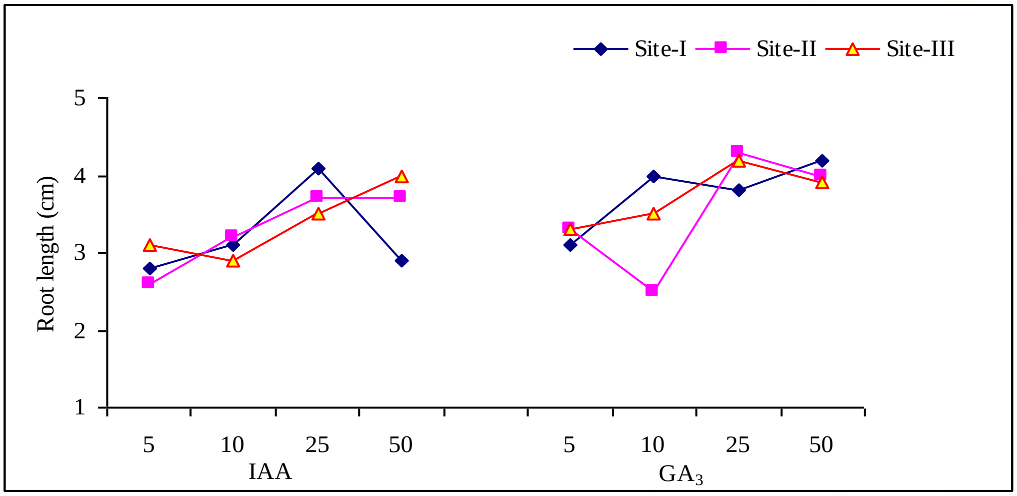



**Fig. 12. Effect of different concentrations (mg $l^{-1}$) of IAA and $GA_3$ (soaked for 48 h) on root length (cm) in *T. undulata* collected from sites I-III.**

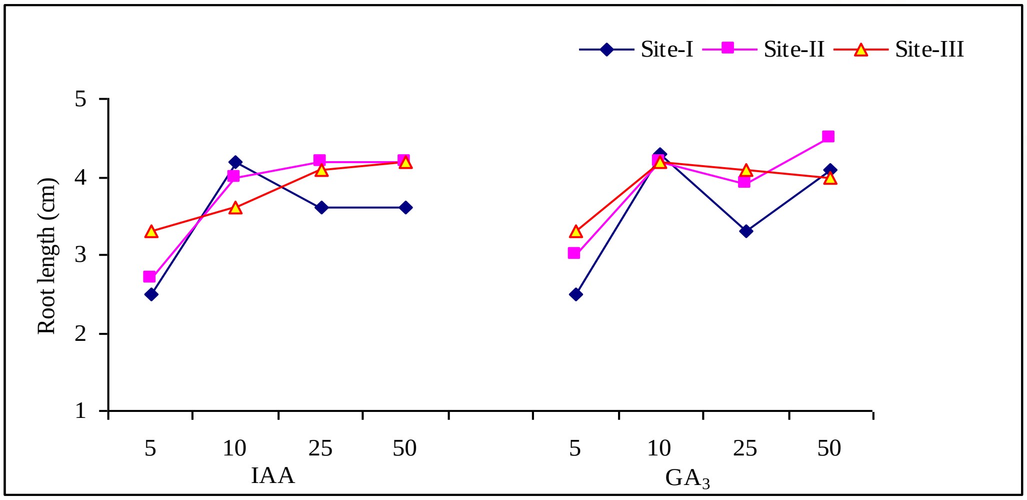


**Fig. 13. Effect of different concentrations (mg $l^{-1}$) of IAA and $GA_3$ (soaked for 24 h) on shoot length (cm) in *T. undulata* collected from sites I-III.**

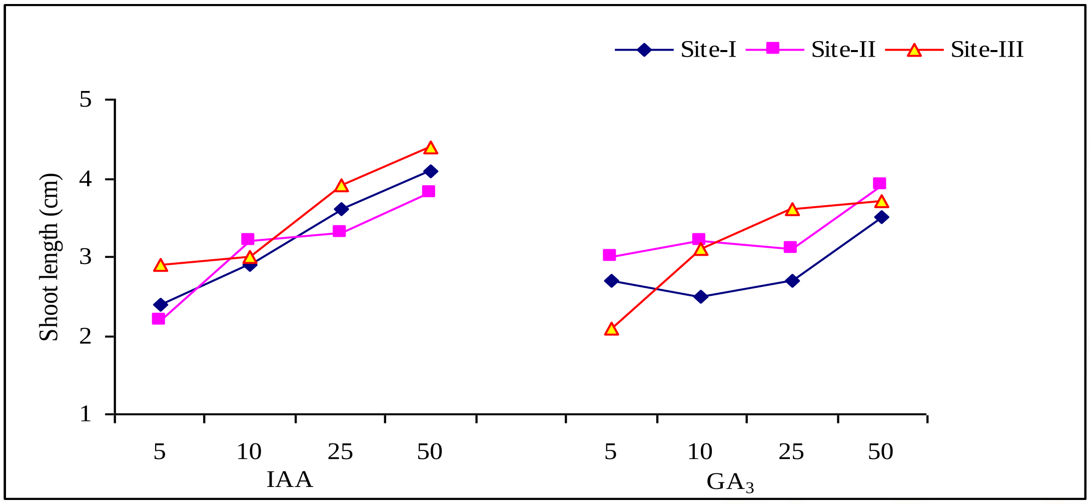
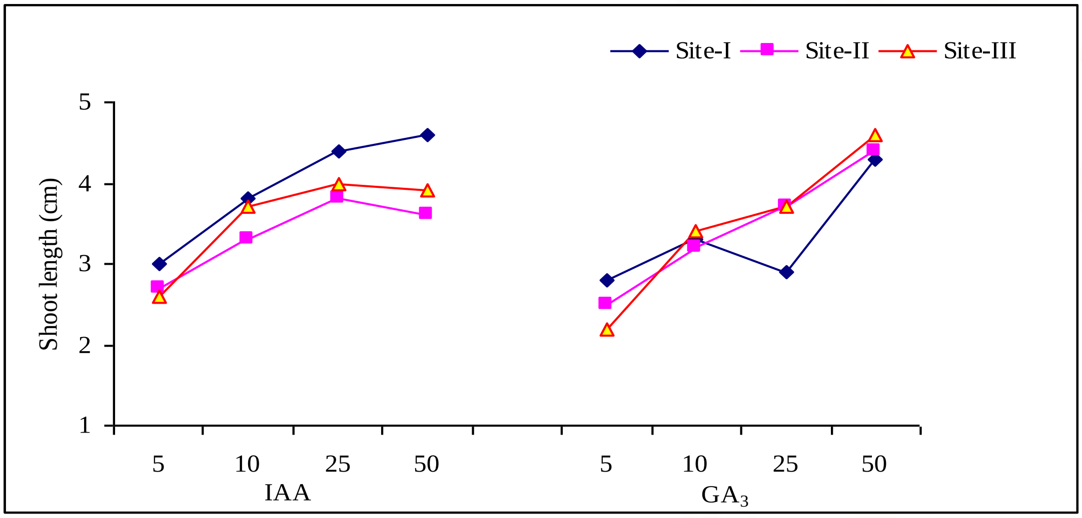



**Fig.14. Effect of different concentrations (mg $l^{-1}$) of IAA and $GA_3$ (soaked for 48 h) on shoot length (cm) in *T.* undulata collected from sites I-III.**




**Discussion-** Most of the arid zone seeds have a long dormancy period often running into several years such as seeds of families Leguminosae, Convolvulaceae, Cucurbitaceae, Boraginaceae, Acanthaceae, etc. (Sen, 1977). The seeds produced through sexual reproduction exhibited morphological and physiological traits that may reflect evolutionary pressures of current or past environments. The nature of germination regulating mechanism in seeds provides itself to an interpretation in terms of survival value of a species. The process of germination and sprouting depends upon the ability of seeds under best possible conditions (Bajpal *et al.*, 2004). The germination regulating mechanisms in desert plants are variable and these differences in the germination behaviour, size and seed weight has been termed as ecological individuality (Sen and Chatterji, 1965). Survival and continuation of plants in desert ecosystem are largely governed by their ability to set viable seeds quickly in enormous numbers, and the ability of the seeds to germinate at intervals over a long period. The variability in seed size, shape, colour and surface are numerous and important in seed identification. The significance of seed size, shape and weight of a particular plant species lies in exhibiting polymorphic or dimorphic conditions, seedling vigour and their establishment under prevailing conditions, especially arid climatic conditions. Most of the seeds in Indian desert are brownish yellow to dark brown in colour. Unevenness of seed size and weight which may be controlled by specific genetic constitution is also influenced by internal competition for food during embryo development and seed maturation. Seed size is found to be under strong genetic influence that is mainly maternal (Sehgal *et al*., 1994; Sharma *et al*., 1994). Seed weight and size offer a rough approximation to the supply of potential energy available for the seedling. The seed weight gives an idea of food reserves available to the embryo for its growth and development, while size affects the vigour and establishment of a plant species. Seed weight is also responsible for the dispersal mechanism of the plant to a large extent. Mohammed (2001, 2007) observed variability in seed weight, shape, size, viability, etc. in *Salvadora persica* and *Tecomella undulata*, collected from different habitats of north-eastern Indian Thar desert. Variability with respect to seed germination and seedling growth among provenances has been reported by Arya *et al*. (1993) in *Tecomella undulata*. Prakash *et al*. (2001 a) reported variability for seed weight, shape, size and viability in *Salvadora persica*. In the present studies, seed variability was observed in *S. persica* and *T .undulata* collected from different sites.

In *S. persica* the seeded fruits are formed from December onwards and by that time seedless fruits start drying and during January they completely dry up and are shed-off. In the present investigations, the seeds collected from the greenish yellow fruit bearing plants exhibited distinct variations in size, colour and weight. The winged seeds of *T. undulata* show polymorphism. Plant produces pods of various sizes, which have seeds of different sizes, shape and weight.

The seeds of both the species indicated a high percentage of germination after certain treatments are provided to them. In the present investigations, seeds of *S. persica* exhibited maximum germination with 50 $mgl^{-l}$ of IAA and 25 $mgl^{-l}$ of $GA_3$ solutions, while seedling growth in 50 $mgl^{-l}$ IAA and $GA_3$ solutions. Seeds of *T. undulata* showed highest germination with 25 $mgl^{-l}$ IAA & $GA_3$, while root & shoot lengths in 25 & 50 $mgl^{-l}$ solutions in both the growth regulators, confirm the earlier observations of various workers.

The seeds of *S. persica* and *T. undulata* had smaller seeds hence they have better dispersion capabilities. Because larger seeds are costly in terms of biomass shifting and more attractive to seed predators, plants undergo selective forces to seed size reduction. $GA_3$ is reported to be more efficient to increase germination as compared with IAA. To get best germination in *S. persica* 10 mg $l^{-l}$ IAA for 48 h and 25 mg $l^{-l}$ $GA_3$ for 24 h; and in *T. undulata* 25 mg $l^{-l}$ IAA and $GA_3$ solutions by soaking seeds for 48 h is recommended for enhancing germination.

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