J. Phytol. Res. **35**(2): 133-137, 2022 **ISSN 0970-5767**

INFLUENCE OF GIBBERELLIC ACID ON SEED GERMINATION AND SEEDLING GROWTH OF *SOLANUM VIRGINIANUM* (SYN. *S. SURATTENSE*): AN IMPORTANT MEDICINAL PLANT OF THE INDIAN ARID ZONE.

ASHA MASIH
Dept. of Botany, Dayanand College, Ajmer, Rajasthan - 305001, India
Corresponding Author's E-mail: asha.masih81@gmail.com

Solanum surattense is an important constituent of well known Ayurvedic drug "Dasmula" and "Arkadhi". All plant parts are used in Ayurveda. The seed paste is applied on toothache and seed powder is smoked in asthma. The plant is very prickly diffuse, procumbent, often becomes perennial reaching a spread of a meter or so under luxuries conditions., Three types of flower bearing plants i.e. dark purple, light purple and white were observed, which differs in their density and colour. The density of white-flowered plants is very low and rarely found in natural habitats. In the present investigations, fresh seeds of *S. surattense* showed maximum germination percentage, root and shoot lengths with 5 mg l-1 GA3, while one year old seeds showed in 50 mg l-1 GA3.The results of Germination value and Vigour Index did not show any definite trend.

Keywords: GA3, Germination value, *S. surattense,* Seed Germination and Vigour Index.

Introduction

S. surattense is used as antiasthmatic, astringent, digestive, diuretic and pungent. The drugs prepared from whole plant are used to treat stomach & throat disorders, dropsy, gum disease, enlargement of liver and spleen. Its extract is effective in bronchial asthma, piles and for rejuvenation[1, 2].

Germination may be defined as an emergence of embryo from the seed by starting a variety of anabolic and catabolic activities like respiration, protein synthesis and mobilization of food reserves after it has absorbed water. To the seed analyst, germination means the emergence and development of the seed embryo of the essential structures that indicate the seed's ability to produce a normal plant under favourable conditions[3]. The factors operating on germination under arid conditions of Rajasthan may be quite different from the moist and warm conditions of eastern part of India[4]. Germination is the process of reactivation of the metabolic machinery of the radicle (root) and plumule (shoot) leading to the development of a seedling[5]. Physiologically, germination begins with the initial stages of biochemical reactivation and ends with emergence of radicle. A germination stimulant such as gibberellic acid can exert its promotive influence to initiate and bring about the process of germination[6]. Seed and seedling vigour has been defined as that condition of active good health and natural robustness in seeds, which upon planting permits germination to proceed rapidly under wide range of environmental conditions[7].

Material and Methods

Collection of Germplasm:

Seeds were collected from the following three sites: Soila village, Dist. Jodhpur (75 km from University Campus in northeast direction; site-I), Kudi Housing Board, Jodhpur (7 km from University Campus in

south direction; site-II), and J.N.V. University Campus, Jodhpur (site-III) during March-April.

For seed collections, mature yellow fruits were selected from branches and stored in paper bags. After drying of fruits, seeds were cleaned and used for germination studies. The following treatments were provided to seeds under nursery conditions.

Seed Viability:

The viability of seeds was tested by the tetrazoilum solution[8]. The seeds were cut into two pieces and kept in 0.1% solution of 2,3,5- triphenyl tetrazolium chloride (TTC) for 3-4 h in dark. If the embryo turned red or pink, then they were considered as viable and viability was calculated on percentage basis.

Seed germination behaviour:

Seed germination behaviour was studied in fresh and one year old seeds. For germination studies, seeds were placed in sterilized petridishes lined with single layer of filter paper. The filter paper was moistened with the required volume of distilled water as and when needed. In all the experiments, each petridish contained 10 seeds in triplicate. The germination experiments were performed in a dark (12 h) obtained from 3 fluorescent tubes of 40 watts each fitted at a height of half meter from the petridishes (1000 Lux) at 28º C in seed germinator. After 10 days of setting the experiments, seed germination (%) and root & shoot lengths of seedlings were measured.

GA3 Treatment:

The seeds were pre-soaked for 24 h in different concentrations (5-100 mg l-1) of GA3. After that seeds were placed for germination studies.

Germination value and Vigour Index:

Germination value (GV) of fresh and one year stored seeds were calculated for each treatment using the following formula[9]:

GV = PV × MDG

Where,

PV = Peak value of germination and it is calculated as follows:

Final germination percentage

Number of days that took to reach the peak germination

MDG = Mean daily germination and calculated with the following formula:

The Vigour Index (VI) was derived from the following formula.[10]

VI = Germination (%) × Seedling length (cm)

Where, Seedling length is the sum of root and shoot lengths.

Results were subjected to analysis of variance (ANOVA)[11].

Results and Discussion

Seed germination behaviour and seedling growth:

It is evident from Table 1 that freshly harvested and one year old seeds showed 80.00 and 16.66% germination in control, respectively. Seed germination in fresh and one year old seeds varied from 86.66 to 100.00 and 46.66 to 86.66%, respectively in GA3 treatment. Cent percent germination was observed in 5 mg l-1 treatment followed by 96.66% in 10 mg l-1 and minimum (86.66%) in 100 mg l-1of GA3 in freshly harvested seeds. In case of one year old seeds, maximum (86.66%) germination was observed in 25 and 50 mg l-1 GA3 solutions. The root & shoot lengths in fresh and one year old seeds ranged from 1.37 to 3.47 & 1.67 to 2.85 and 1.26 to 3.26 & 1.53 to 4.14 cm, respectively. The maximum seedling growths in fresh and one year old seeds were observed with 5 and 50 mg l-1 GA3 solutions, respectively. Highest R/S ratio was observed in 5 mg l-1 GA3 solution. The data were significant at 5 and 1% probability levels.

Thus, 5 mg l-1 of GA3 solution treatment was suitable for obtaining maximum germination percentage and seedling growth in freshly harvested seed.

Table 1. **Effect of different concentrations of GA_3 on seed germination, seedling growth and R/S ratio in fresh and one year old seeds of *S. surattense.***

Conc. (mg l^{-1})	Germination (%)		Seedling growth (cm)				R/S ratio	
	Fresh	Old	Root		Shoot			
			Fresh	Old	Fresh	Old	Fresh	Old
Control	80.00	16.66	1.37	1.26	1.67	1.53	0.834	0.833
5	100.00	46.66	3.47	2.75	2.85	2.89	1.253	0.971
10	96.66	83.33	2.43	2.43	2.22	3.34	1.126	0.739
25	93.33	86.66	2.19	2.48	2.10	3.52	1.069	0.710
50	90.00	86.66	2.71	3.26	2.41	4.14	1.193	0.797
100	86.66	66.66	2.18	2.05	2.09	3.29	1.086	0.629
CD	NS	40.496*	0.483**	0.402**	0.475**	0.375**	0.263*	0.171**

NS= Non-significant; and * & ** = Significant at P = 5 &1%, respectively.

Seed germination value and Vigour Index:

It is evident from Table 2 that MDG in fresh and one year old seeds ranged from 8.00 to 10.00 and 1.66 to 8.66, respectively. Fresh and one year old seeds showed maximum values of MDG in 5 and 50 mg l-1 GA3 respectively, while minimum in control. The fresh seeds showed highest GV and VI in 5 mg l-1 GA3 solution, while lowest in control. One year old seeds exhibited these values maximum in 50 mg l-1 GA3 solution.

Table 2. Effect of different concentrations of GA_3 on seedling parameters in fresh and one year old seeds of *S. surattense.*

Conc. (mg l^{-1})	Parameters							
	Fresh				Old			
	PV	MDG	GV	VI	PV	MDG	GV	VI
Control	8.88	8.00	71.11	243.20	2.08	1.66	3.46	46.48
5	9.00	10.00	111.11	632.00	5.18	4.66	24.19	263.16
10	9.66	9.66	93.43	449.46	8.33	8.33	69.43	480.81
25	9.33	9.33	87.10	400.38	10.83	8.33	93.87	519.96
50	9.00	9.00	81.00	384.30	14.44	8.66	125.16	641.28
100	8.66	8.66	75.09	443.69	7.40	6.66	49.37	355.96

PV = Peak value of germination; MDG = Mean daily germination; GV = Germination value; and VI = Vigour Index.

In the present studies, the seeds of *S. surattense* collected from different sites exhibited to 80 to 93.33% viability,

The enhanced seed germination is attributed to the stimulation of hydrolytic enzymes such as lyases and deydrogenases by GA3, which bring about the breakdown of stored food materials into sugars and thus promoting germination through cell division and cell expansion[12]. Seeds of *W. somnifera* pre-treated with 1000 ppm of GA3 resulted in vigorous growth of seedlings[13]. GA3 is one of the hormones proposed to control primary dormancy by inducing germination[14]. Highest germination percentage in *Teucrium polium* when pre-treated with 500-2500 ppm GA3[15]. The seeds of *Alstonia scholaris* treated with 100 ppm of GA3 showed highest vigour index[16]. Highest vigour index and germination velocity index obtained in *Ocimum canum* and *O. basilicum* seeds pretreated with 20 ppm of GA3[17]. 80% germination in *Panicum antidotale* with 20 ppm of GA3 treatment[18]. *Zygophyllum simplex* showed maximum germination with 50 ppm GA3 soaked for 48 h[19].

Conclusion

It is concluded from the present studies that seeds of *S. surattense* showed maximum germination percentage and seedling growth with 5 mg l-1 GA3. The R/S ratio was found to be highest in fresh seeds of *S. surattense* 5 mg l-1 GA3. The results of GV and VI did not show any definite trend. Germination inhibitors have been found in the embryo, endosperm and seed coats and in structures that sometimes are dispersed along with the seeds of some species. The germination promoting effect of gibberellins (GA3) is well documented in mature seeds of a number of species[20,21]. The soaking of seeds in GA resulted improvement in germination over control and indicated that exogenous gibberellic acid treatment achieved the balance of growth promoters and inhibitors[22].

Acknowledgement

I am very grateful to Professor & Head, Department of Botany, J.N.V. University, Jodhpur to provide valuable laboratory facilities.

References

1. Chakraborty MK, Bhattacharjee A and Pal DC 2003, Ethnomedicinal uses of some exotic plants of Purulia district, West Bengal, India. In: *Ethnobotany and Medicinal Plants of India and Nepal* **2** 559-563.
2. Kumar S, Parveen F and Narain, P 2005, *Medicinal Plants in the Indian Arid Zone.* CAZRI, Jodhpur, pp 64.
3. Desai BB, Kotecha PM and Salunkhe DK 1997, S*eeds Handbook: Biology, Production, Processing and Storage.* Marcel Dekker, Inc., New York, pp 627.
4. Sen DN 1977, *Environment and Seed Germination of Indian Plants.* The Chronica Botanica Co., New Delhi.
5. Jann RC and Amen RD 1977, What is germination? In: *The Physiology and Biochemistry of Seed Dormancy and Germination,* (Ed..) Khan AA, North Holland Publishing Co., Amsterdam, pp 7-28.
6. Amen RD 1965, A model of seed dormancy. *Bot. Rev.* **34** 1-31.
7. Mehta N, Beohar ABL, Rawat GS and Mishra Y 2000, A biometrical approach to express stability of soybean seed and seedling vigour over variable dates. *Seed Research* **28** 97-98.
8. Porter RH, Durell M and Room HJ 1947, The use of 2,3,5- triphenyl tetrazolium chloride as a measure of seed germinability. *Plant Physiol.* **22** 149-159.
9. Czabator FJ 1962, Germination value: an index combining speed and completeness of pine seed germination. *Forest Sci.* **8** 386-396.
10. Abdul-Baki AA and Anderson JD 1973, Vigour determination in soybean seed by multiple criteria. *Crop Sci.* **13** 630-633.

11. Gomez KA and Gomez AA 1984, *Statistical Procedures for Agricultural Research.* (2nd ed.). John Wiley & Sons, New York, p 294.
12. Puls EE (Jr.) and Lambeth VN 1974, Chemical stimulation of germination rate in aged tomato seeds. *Amer. Soc. Hort. Sci.* **99** 9-12.
13. Verma S, Sharma RK and Shrivastava DK 2001, Seed germination, viability and invigoration studies in medicinal plants of commercial value. In: *Proceedings of the National Seminar of Frontiers of Research and Development in Medicinal Plants,* (Eds.) Kumar S, Hasan SA, Dwivedi S, Kukreja AK, Sharma A, Singh AK, Sharma S and Tewari R. CIMAP, Lucknow, pp 426-428.
14. Iglesias RG and Babiano MJ 1997, Endogenous abscisic acid during the germination of chickpea seeds. *Physiol. Plant.* **100** 500-504.
15. Nadjafi F, Bannayan M, Tabrizi L and Rastgoo M 2006, Seed germination and dormancy breaking techniques for *Ferula gummosa* and *Teucrium polium. Jour. Arid Environ.* **64** 542-547.
16. Kundu M, Sharma P, Kachari J and Sett R 1997, Effect of pretreatment on germination and seedling vigour in Alstonia scholaris. *Seed Research.* **25** 16-18.
17. Gupta SC 2002, Seed dormancy studies in some *Ocimum* species and its control through chemical treatment. *J. Med. & Aro. Pl. Sci.* **24** 957-960.
18. Shahi AK 1990, Ecological studies on some desert grasses with special reference to *Cymbopogon jwarancusa* (Jones) Schult. Ph.D. Thesis, Univ. of Jodhpur, Jodhpur, India.
19. Mohammed S and Sen DN 1992, Effect of GA3 and different nitrates on seed germination of *Zygophyllum simplex* (Linn.), an inland halophyte of Indian desert. *Proc. Nat. Acad. Sci. India.* **62** 393-397.
20. Hilhorst HWM 1995, A critical update on seed dormancy. I. Primary dormancy. *Seed Sci. Res.* **5** 61-73.
21. Karssen CM 1995, Hormonal regulation of seed development, dormancy and germination studies by genetic control. In: *Seed Development and Germination*, (Eds.) Kigel J and Galili G. Marcel Dekker, New York, pp 333-350.
22. Singh H, Kaur J and Singh G 1995, Improvement of germination in Guina grass (*Panicum maximum* Jacq.). *Seed Research.* **23** 132-133.