Elliot, F. C. 1958. *Plant breeding and cytogenetics.* McGraw Hill Book Co., N.Y.
Emsweller, S. L. and N. L. Ruttle. 1941. Induced polyploidy in floriculture. *Amer. Nat.*, 75 : 310–26.
Jain, H. K., R. S. Rana, S. Jana, M. P. Alexander and J. N. Sharma. 1962. A study of fertility and phenotype in induced tetraploids of *Antirrhinum. Indian J. Genet.*, 22 : 154–9.
Randolph, L. F. and H. E. Fischer. 1939. The occurence of parthenogenetic diploids in tetraploid maize. *Proc. Nat. Acad. Sci*, 25 : 161–4.
Stebbins, G. L. 1957. Genetics, evolution and plant breeding. *Indian J. Genet.*, 17 : 129–41.
Torres, A. M. 1961. Cytotaxonomy of Caespitose *Zinnias*. *American J. Bot.*, 49 : 1033–7.

https://doi.org/10.29321/MAJ.10.A03583

Studies on the Floral Biology and Fruit-set in Onion (*Allium cepa* L.) - I

by

D. DANIEL SUNDARARAJ[1], V. RAMAKRISHNAN[2] and S. D. RAMAKRISHNAN[3]

Inrtoduction : The importance of floral biological studies in projects aiming at crop improvement work is well known. The exact technique to be employed in breeding programme for the evolution of strains with desirable attributes is dependent on the selfed or open pollinated nature of the crops concerned, which itself is determined by the genetic and physical barriers existing in those crops. The present studies were therefore, carried out with four different cultivars of cepa or common onion from commercial sources with the same object in view.

Review of Literature : Onion is one of the few crops which has received considerable attention at the hands of plant breeders and geneticists (Jones and Emsweller, 1934; Jones, 1937; Jones and Clarke, 1947; Trofimec, 1940; Becker, TH., 1943–44; Ustinova, 1950 and Agati, (1952), Hawthorn and Pollard (1953) and Jones and Mann (1963) have reviewed excellently the various aspects of research carried out with this crop. Although several of the European and American varieties of onion have been introduced into our country and grown for over six decades, only recently crop improvement work has been initiated in this crop. The earlier work in onion in our country was primarily concerned with agronomic aspects of production and floral biology in this crop, does not appear to have been studied.

Jones (1937), Jones and Mann (1963) have dealt in great detail with the anthesis and pollination in onion grown for seeds, besides describing the floral structures. According to him the pollen of a single flower is shed over a period of 24 to 72 hours from the time of flower opening and long before

1. Systematic Botanist and Associate Professor of Botany, 2. Assistant Botanist and
3. Formely Assistant in Botany, Agricultural College and Research Institute, Coimbatore-3.

the style becomes receptive. Most of the pollen is shed between 9 a. m. and 5 p. m. The style is 1 mm long when the flower first opens, not reaching its maximum length of about 5 mm until a day or two, after all the pollen from that flower has been shed. Hawthorn and Pollard (1953) state that the stigma becomes receptive only when it elongates to a length of about 5 mm. Agati (1952) also has studied the floral biology in onion in connection with the production of pure seed and concluded that the onion is protandrous, and cross fertilised, the pollination being usually performed by bees thus, confirming the findings of Trofimec (1940), Becker, TH. (1943–44) and Ustinova (1950). Ustinova (1950) has found out that in *Allium* spp. pollen tube takes 16–18 hours to reach the ovules and fertilization occurs only 20–24 hours after pollination.

Materials and Methods: Three types of onion CV. Bellary Red (C. S. 412, 422 and 467), one type of CV. Bangalore Brown (C. S. 420) and two types of CV. White Globe (C. S. 435 and 462) were studied for the floral biology. Of these types, C. S. 422 and 467 were utilised for conducting studies on stigma receptivity alone. In each of these collections except C. S. 422 and 467 five plants were selected at random and in each plant two flowers from an inflorescence were studied. Ten flowers observed in each collection had not only belonged to different plants but also opened during different periods in a day. For studying the receptivity of stigma, flowers which had opened simultaneously only, were selected from three plants in each of the two selected types. The duration of flowering, anthesis and its duration, interval between the dehiscence of one anther and the other, elongation of the style and the total time taken for its complete exertion, the time taken for the stigma to become receptive and the duration of receptivity and percentage of fruit-set have all been studied and the data are furnished in the tables.

Discussion: It has been observed that the inflorescence stalk (scape) required 14 to 16 days for its complete emergence and full development depending upon the cultivars. The cylindrical and fistular peduncle was somewhat swollen near about the middle with the small cymose umbel situated at its apex, enclosed within a papery spathe consisting of three bracts. About four to six days prior to the cessation of growth of the stalk, the enclosed umbel, which all the while remained small, had started expanding. As a result, the spathe was split open due to pressure exerted by the enlarging flower buds and the bracts reflexed. Then, the flowering commenced and lasted for a period ranging from 9 to 18 days in each inflorescence, the duration varying with the types (Table 1). The flowers opened during day time only, from 6 a. m. to 5 p. m. every day. The number of flowers that opened between 7 a. m. and 1 p. m. was comparatively high and in particular, the number of flowers that opened at 7 a. m. every day was large in the

majority of the collections studied. Peak flowering period was observed to vary with the collection. Thus, the number of flowers that opened on any single day was more between fourth and eighth day in C. S. 412, sixth and eleventh day in C. S. 420, seventh and fifteenth day in C. S. 435 and third and fifth day in C. S. 462 (Table 1).

The inner whorl of stamens was noticed to stand erect at the time of flower opening, while the outer whorl of stamens remained deflexed at right angle to the floral axis and incurved to begin with. The outer whorl of stamens had assumed the erect position only when all or most of the anthers of the inner whorl had dehisced to shed their pollen. Occasionally flowers with seven or eight stamens and fasciated double flowers with different degrees of fusion between the ovaries were found to occur in type C. S.435.

The anthesis studied had shown that anther dehiscence in all the types generally took place between 9 a. m. and 5 p. m. but in few plants in type C. S. 462 it had commenced as early as 7. a. m. The percentage of flowers opened before 1 p. m. ranged from 65.6 to 71.4 in the varieties studied. In all the types in flowers with the exception of one or two that opened before 10 a. m. every day, the anther dehiscence had commenced the same day, while in the rest it had started only the next day. The duration of anther dehiscence in each whorl was observed to range from 1 to 7 hours in the majority of the flowers, while in a few cases it extended upto 26 hours. The anthers in both the whorls dehisced one after another at irregular intervals, the intervals ranging between 1 and 25 hours. The total time taken for the completion of dehiscence in both the whorls of stamens was found in majority of the types to range between 21 and 30 hours, but in a few flowers in C. S. 412 and C. S. 420 and in nine out of 10 in C. S. 462 it was observed to range between one and nine hours.

The style at the time of flower opening was less than 1 mm. in length and had reached 5 mm. after about 56 to 57 hours. The emasculated flowers on periodical dusting with freshly collected pollen at about four hourly intervals, and observing the fruit-set, had revealed that the stigma, contrary to the reporting of Jones (1937), Jones and Mann (1963) and Hawthorn and Pollard (1953), however, became receptive after 14 hours from the time of flower opening and long before the style had grown to a length of 5 mm. and continued to remain receptive even upto 48 hours from the time of flower opening under the conditions obtainable in this tract.

Pollination was obesrved to be effected by dammer bees *(Melipona iridipennis)*, house-fly *(Musca domestia)* and common black-ants *(Camponotus compressus)*, besides the honey bees which visited the flowers for the pollen and nectar.

TABLE 1. *Table showing the details of flowering in Onion*

Type, Number & Varietal Name	Duration of flowering in days	Mean duration of flowering in days	Peak flowering period	Mean flowers opening during different hours											
				6 a m.	7	8	9	10	11	12 Noon	1	2	3	4	5 p.m.
C.S. 412 C.V. Bellary Red	9 to 12	10.25	Between 4th & 8th day	5.0	21.4	7.2	7.6	6.0	7.4	10.0	9.8	4.0	6.4	7.6	4.8
C.S. 420 C.V. Bangalore Brown	10 to 16	13.3	Between 6th & 11th day	0.3	23.6	3.0	7.0	4.3	4.6	9.0	4.3	6.0	5.3	3.0	5.3
C S. 435 C.V. White Globe-Ooty	9 to 18	12.4	Between 7th & 15th day	0.8	22.4	5.0	7.0	7 2	5.8	9.8	5.4	4.8	4 6	5.4	2.6
C.S. 462 C.V. White Globe-Nasik	10 to 11	10.25	Between 3rd & 5th day	1.8	11.8	3.8	5.0	4.2	3.8	8.2	6.0	2.0	4.2	3.6	4.4

TABLE 2. *Table showing the details of flowers borne and those that had set seeds in Onion*

Type No.	Total number of inflorescences	Total number of flowers borne			Percentage of flowers that set seeds		
		Maximum	Minimum	Mean	Maximum	Minimum	Mean
C.S. 412	37	233	60	104	92.7	37.5	72.3
C.S. 420	3	67	48	57	73.1	19.6	44 8
C.S. 435	6	195	69	116	88 5	20·5	60.4
C S. 462	20	135	32	82	91.0	12.9	48.8

TABLE 1. *Effect of salinity on the germination and seedling growth of IR. 8*

Treatment No.	Germination %	% on control	Shoot height (cm)	% on control	Root length (cm)	% on control	S. R. Ratio	Dry matter content of 100 seedlings (g)	% on control
C	97.2	100.00	8.9	100.00	11.5	100.00	1.29	1.98	100.00
T_1	90.0	92.52	10.1	113.12	13.9	119.54	1.37	1.70	94.35
T_2	87.0	89.44	10.1	113.12	13.6	116.96	1.34	1.51	83.81
T_3	83.0	85.32	8.6	96.32	12.5	107.50	1.45	1.52	84.36
T_4	75.0	77.10	8.5	95.20	13.3	114.38	1.56	1.25	69.38
T_5	72.0	74.02	8.0	89.60	12.2	104.92	1.52	1.11	61.61
T_6	57.4	58.11	7.8	87.36	9.2	79.12	1.17	1.12	62.16
Whether Significant	Yes (p:0.01)		Yes (p:0.01)		Yes (0.05)				
S.E.	1.53		0.62		1.24				
C.D.	4.06		1.64		3.29				

Conclusion :

a) Germination C T_1 T_2 T_3 T_4 T_5 T_6

b) Shoot height T_1 T_2 C T_3 T_4 T_5 T_6

c) Root length T_1 T_2 T_4 T_3 T_5 C T_6

All the concentrations except the highest (6000 ppm) increased the root length as compared to the control. Statistically except the highest concentration, others were on par and significant at 5% level. The shoot/root ratio was highest in the sample which received 4000 ppm and lowest in the highest concentration (6000 ppm). The dry matter content was high in the control with 1.98 g per 100 seedlings and in the remaining treatments the dry matter production was low. The salinity levels had some specific influence on the uptake of nitrogen, phosphorus, pottassium and sodium (Table 2). Maximum nitrogen content was seen in sample drawn from the lowest concentration of 1000 ppm. The concentrations of 2000, 3000 and 4000 ppm also registered more values than the control. The two highest concentrations reduced the percentage of nitrogen.

The trend was somewhat similar as regards phosphorus content in the seedlings. The maximum content was seen in the lowest concentration. The levels of 2000 and 3000 ppm also gave higher values than the control. The three highest concentrations reduced the phosphorus content and no relationship could be seen between the levels and phosphorus content. The

TABLE 2. *Effect of salinity on certain mineral contents of IR.-8 paddy*

Treatments	N %	% on control	P %	% on contral	K %	% on control	Na %	% on control
C	2.05	100.00	0.15	100.00	0.65	100.00	0.2	100.00
T_1	2.80	136.58	0.18	118.88	0.70	107.80	1.0	500.00
T_2	2.44	119.02	0.16	106.56	0.70	107.80	1.1	550.00
T_3	2.33	113.65	0.17	113.22	0.76	117.04	1.0	500.00
T_4	2.41	117.56	0.13	86.58	0.80	123.20	1.2	600.00
T_5	1.85	90.24	0.13	86.58	0.30	123.20	1.4	700.00
T_6	1.92	93.65	0.14	93.24	0.70	107.80	1.4	700.00

percentage of potassium was increased due to induced salinity. Except in the highest concentration (6000 ppm) there was some indication of relationship between concentrations and potassium content. The content of sodium was increased enormously by the salinity levels in respect of the treatments which depended largely on the concentration used.

Discussion: Salinity levels exhibited pronounced influence on the germination of IR.8 rice. There was significant inhibition of germination in relation to concentration as reported by Pearson and Ayers (1960). The seedling growth revealed that tolerance or sensitivity factors cannot be evaluated at germination stage, although the germination was progressively affected by higher concentrations of added salts. There was sufficient indication that lower concentrations actually increased the shoot height, root length and shoot root ratio. Ayers and Hayward (1948) made a statement that " there is no general relation between the salt tolerance of plant during the later phases of growth and of that during germination. Salinity affects the the germination and increased the accumulation of toxic ions ". The present work agreed with the above observations of early workers on the two aspects.

The total nitrogen was sufficiently increased by induced salinity. This was the experience of Shimose (1963), Narasingha Rao (1964) and Balasubramanian (1965) with several rice varieties. Sarin (1964) made similar observation in wheat. Regarding phosphorus content, many workers reported that the phosphate content increased appreciably under saline condition and that "the restricted growth characteristic of saline treatment was probably the principal factor responsible for the increase in phosphate content (Ehrler and Bernstein 1958)". Murty and Narasingha Rao (1963) held different views. In the present investigation the lower concentrations increased the values while the higher concentration lowered the phosphorus content. Thus it seems to be a varietal character and cannot be a general rule in all crops. The potassium content was increased in all the concentrations and this was progressively so

till 5000 ppm. Earlier workers such as Ehrler and Bernstein (1958) held the view that salinization progressively reduced potassium content. The present investigation did not agree with the above observations as far as the chosen variety was concerned. Regarding sodium content the earlier opinion has been that all varieties accumulate sodium when grown in saline conditions. There is an opinion that sensitive strains accumulate more of sodium as compared to tolerant vaieties. The high accumulation of sodium itself may be an indication for the susceptibility of the strain to salinity. Even the lowest concentration of 1000 ppm increased the sodium content by 500% in IR.8. A study till harvest may give a better idea of the tolerance or otherwise of IR.8 to salinity.

Summary: In the present investigation the effect of six salinity levels ranging from 1000 to 6000 ppm were studied on IR.8 variety of rice (*Oryza sativa L*) Germination was inhibited progressively by induced salinity and in the highest concentration of 6000 ppm it was reduced to 57.4%. A study of the following factors in 10 day old seedlings gave the results indicated below:

As regards shoot height the lowest two concentrations of 1000 and 2000 ppm increased the values while the higher concentrations caused a reduction. The length of root was increased to all the treatments except the highest level. The nitrogen content was increased up to 4000 ppm. Similarly phosphorus content was increased in samples grown in the lower three concentrations. The percentage of potassium was enhanced in all the treatments except the control. There was a good relationship between the salinity levels used and the sodium content in the seeding.

REFERENCES

Ayers, A. D. and H. E. Hayward. 1948. A method for measuring the effect of soil salinity on seed germination with observations on several crop plants. *Soil. Sci. Soc. Amer. Proc.*, **13**. 224-26.

Balasubramanian, V. 1965. Effect of salinity on certain physiological factors in rice (*Oryza sativa* L.) M.Sc. (Ag,), Diss. Madras Univ. (unpub)

Ehrler, W. and L. Bernstein. 1958. Effects of temperature, mineral nutrition and salinity on the growth and composition of rice. *Bot. Gaz.*, 120 : 67-74.

Murty, K. S. and C. H. Narasingha Rao. 1963. Physiology of salt tolerance. *Agrl. Res.*, 3 : 103.

Narasingha Rao, C. H. 1964. Physiological studies on salt tolerance in rice. *Agrl. Res.*, 4 : 169.

Pearson, G. A. and A. D. Ayers. 1960. Rice as a crop for salt affected soil in process of reclamation. *U.S.D.A. Production Research Report No. 43.*

Sarin, M. N. 1964. Physiological study of the effect of salinity on the growth of wheat. *Agrl. Res*, 4 : 82.

Shimose, N. 1963. Physiology of salt injury in crops. *Fld Crop. Abstr.*, 17 : 1460.