

## PHYSIOLOGICAL TRAITS AND PRODUCTIVITY OF RAINFED CHICKPEA IN RELATION TO UREA SPRAY AND GENOTYPES

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### ABSTRACT

A field experiment was carried out to study the effect of three concentrations of urea @ 0.25, 0.50 and 1.0% as foliar spray at 45 and 65 days after sowing against control on three chickpea genotypes namely KDG-1168, Udai and Awarodhi during rabi 2005-06 and 2006-07 under rainfed condition. At 50% flowering stage, nitrate reductase activity (NRA), relative water content (RWC) and chlorophyll content were estimated and found maximum with 1.0% urea spray. All the genotypes significantly improved their NRA, RWC and chlorophyll content in leaf with increase in urea concentrations upto 1.0%. Plant height, 1000-seed weight and harvest index also improved significantly upto 1.00%. Number of branches-1 plant showed significant increase only upto 0.5% urea spray. Whereas seed yield of all genotypes increased upto 1.00% urea spray. Among genotypes, 'Awarodhi' was found significantly superior followed by 'Udai' in almost all characters studied.

**Key words :** Physiological traits, Productivity, Chickpea, Urea spray.

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### INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an important pulse crop of India. The major area under chickpea is unirrigated where, productivity is very low as compared to yield potential of different genotypes. However, water stress is one of the main environmental stresses responsible for reducing crop productivity as it affects growth through various physiological and metabolic processes of plant (Bray 1993). Vital biochemical processes including photosynthesis (Boyer 1976), respiration (Bell *et al.* 1971), protein synthesis (Good and Zaplachinski; 1994), nucleic acid synthesis (Deltour and Jacquard 1974) assimilation of inorganic nitrogen (Munjil *et al.* 1998) and biological nitrogen fixation (Sprent 1981) have been demonstrated to be adversely affected by water stress. Hence, there is a need for increasing crop productivity particularly in rainfed situation. Foliar spray of urea solution at vegetative growth periods may help to reduce the adverse effect of moisture stress on crop plants. An experiment was, therefore, carried out to study the effect of different urea concentrations for foliar spray three varied genotypes of chickpea under rainfed condition in Central Uttar Pradesh.

### MATERIAL AND METHODS

The field experiment was conducted during rabi 2005-06 and 2006-07 at Oilseed Research Farm, C.S. Azad University of Agriculture and Technology, Kanpur under rainfed condition. The soils of experimental sites were loaming sand having pH 7.7 and 7.8, EC 0.39 and 0.44 dSm<sup>-1</sup> and organic carbon 0.32 and 0.35 % during first and second year, respectively. The treatments comprised 12 combinations of 4 concentrations of urea spray *viz.*; control (no spray), 0.25%, 0.50% and 1.00% and 3 genotypes of chickpea *viz.* 'KGD-1168', 'Udai' and 'Awarodhi'. All the 12 treatments were tried in randomized block design with 3 replications. A uniform dose of 100Kg DAP ha<sup>-1</sup> was applied as basal to all treatment plots. Sowing of treated seed with Rhizobium culture was done on 15.11.2005 and 11.11.2006 after pre-sowing irrigation during two years respectively, in furrows 30cm apart behind *deshi* plough. Spraying of urea at different concentrations as per treatment was done on plant foliage twice, *i.e.*, 45 and 65 days after sowing in each year by using 800 lit solution/ha. The data were recorded on Nitrate Reductase Activity (NRA),

Relative Water Content (RWC) and Chlorophyll content in leaves at 50% flowering stage of the crop. RWC in top to second leaf was estimated as per method of Barrs and Weather (1962) Nitrate reductase activity (NRA) in same leaf was estimated by the method of Klepper *et al.*, (1971) while the chlorophyll content in leaf was determined by using the method of Arnon (1949). For the purpose, 5 plant samples were randomly collected from each net plot area. Observations on growth yield attributes and yields were recorded at harvest of crop. Experimental crop was harvested on 10.04.2006 and 08.04.2007 during two years. Crop in the whole life cycle received total rainfall of 36.0 and 61.8 mm during first and second year, respectively.

### RESULTS AND DISCUSSION

**Effect of urea spray :** Effect of foliar spray of urea with different concentrations was found significant on all plant characters including yield (Table 1). The physiological traits of chickpea, *viz.*, NRA, RWC and Chlorophyll content in leaves attained significantly maximum values with 1% urea spray while the lower concentrations of 0.25 and 0.50% urea spray failed to show significant increase over control in almost all cases. Decrease in RWC (Chandra Shekhar *et al.* 2000) in wheat and NRA (Reddy *et al.* 1990) in horsegram under soil water stress conditions has earlier been reported. The spray of urea solution at higher concentration of 1% might have increased the nitrogen and water content in leaves, which resulted in significant improvement of above-mentioned characters of plant leaf. In case of other plant characters, plant height, 1000-seed weight and harvest index increased significantly with 0.25% urea spray over control but the further increase in urea concentration could not show any improvement in these characteristics of chickpea during either year. Number of branches plant<sup>-1</sup> increased significantly with increasing urea concentration upto 0.50% where significantly maximum number of branches plant<sup>-1</sup> were counted. Further increase in urea concentrations at 1% caused significant reduction in number of branches. The increased availability of nitrogen and water to plants through foliar spray may be responsible for improvement in growth and yield attributes of rainfed chickpea.

Seed yield increased with increase in concentrations of urea spray upto 1% but the increase beyond 0.5% urea concentration was not significant. The seed yield was attributed mainly to number of branches Plant<sup>-1</sup> and partially to 1000-seed weight and harvest index. Number of seeds pod<sup>-1</sup> also increased with foliar spray of increasing urea concentrations but differences could not touch the level of significance. Such improvement in seed yield may be due to favourable effect of nitrogen at grand growth period which later on translocated to pods and seeds in reproductive phase. Saxena and Srivastava (1997-2001) also reported the similar results in case of 'Awarodhi' genotypes of chickpea.

**Effect of chickpea genotypes :** Chickpea genotypes varied significantly from each other in most of the characters studied. The genotypes 'Awarodi' attained significantly maximum values chlorophyll content in leaves, plant height and number of branches plant<sup>-1</sup>. In case of NRA, though 'Awarodhi' maintained higher value during both years but in first year, 'Udai' was also found at par with 'Awarodi'. Effect of genotypes on RWC was significant only during first year when 'Awarodi' and 'Udai' being at par with each other proved significantly superior over KGD-1168. Similar was the behaviour in case of 1000-seed weight during both years. Number of seeds pod<sup>-1</sup> and harvest index were not influenced significantly by different genotypes. Such variations among genotypes might be due to genetic constitution of different genotypes which provided inherent capacity to perform genotypes in different ways. Varietal variations in different physiological traits of chickpea have also been reported by Poonam Sharma *et al.* (2003). In case of productions, 'Awarodi' produced significantly maximum and KGD1168 produced significantly minimum seed yield during both years of experimentation. These yields may be attributed mainly to number of branches plant<sup>-1</sup>, which also behaved in the same manner. Besides, yield potential of different genotypes depends on their genetic constitution, which varies from genotype, to genotype.

**Effect of urea spray x genotypes interaction :** The interaction effect of urea spray x genotypes

**Table 1.** Effect of urea spray x genotypes on the performance of rainfed chickpea.

| Character          | NRA*    |         | RWC*    |         | Chlorophyll content* |         | Plant height (cm) |         | No. of branches plant <sup>1</sup> |         | No. of seed pod <sup>1</sup> |         | 1000- seed weight (g) |         | Seed yield (kg ha <sup>-1</sup> ) |         | Harvest index (%) |         |  |
|--------------------|---------|---------|---------|---------|----------------------|---------|-------------------|---------|------------------------------------|---------|------------------------------|---------|-----------------------|---------|-----------------------------------|---------|-------------------|---------|--|
|                    | 2005-06 | 2006-07 | 2005-06 | 2006-07 | 2005-06              | 2006-07 | 2005-06           | 2006-07 | 2005-06                            | 2006-07 | 2005-06                      | 2006-07 | 2005-06               | 2006-07 | 2005-06                           | 2006-07 | 2005-06           | 2006-07 |  |
| Urea spray         |         |         |         |         |                      |         |                   |         |                                    |         |                              |         |                       |         |                                   |         |                   |         |  |
| Control            | 1.98    | 2.28    | 64.3    | 65.0    | 2.66                 | 2.70    | 45.6              | 47.6    | 23.3                               | 24.9    | 1.59                         | 1.60    | 156.3                 | 156.0   | 1595                              | 1690    | 23.5              | 25.6    |  |
| 0.25%              | 1.99    | 2.41    | 65.7    | 66.7    | 2.75                 | 2.65    | 46.4              | 48.9    | 24.5                               | 25.4    | 1.66                         | 1.71    | 157.7                 | 159.3   | 1655                              | 1817    | 24.8              | 26.6    |  |
| 0.50%              | 2.04    | 2.36    | 68.6    | 67.3    | 2.84                 | 2.87    | 45.1              | 49.6    | 25.9                               | 27.0    | 1.71                         | 1.74    | 158.9                 | 159.5   | 1743                              | 1911    | 25.0              | 26.4    |  |
| 1.00%              | 2.66    | 2.72    | 72.0    | 71.9    | 3.03                 | 2.97    | 45.6              | 49.8    | 23.8                               | 25.4    | 1.75                         | 1.76    | 158.7                 | 159.5   | 1745                              | 1981    | 25.4              | 26.6    |  |
| S.Em. ±            | 0.04    | 0.03    | 1.5     | 1.4     | 0.04                 | 0.01    | 0.1               | 0.4     | 0.2                                | 0.2     | 0.56                         | 0.58    | 0.5                   | 0.4     | 23                                | 37      | 0.3               | 0.3     |  |
| C.D. 5%            | 0.12    | 0.08    | 4.3     | 4.1     | 0.12                 | 0.03    | 0.3               | 1.3     | 0.6                                | 0.6     | NS                           | NS      | 1.4                   | 1.2     | 67                                | 110     | 0.8               | 0.8     |  |
| Chickpea genotypes |         |         |         |         |                      |         |                   |         |                                    |         |                              |         |                       |         |                                   |         |                   |         |  |
| KGD-1168           | 1.99    | 2.32    | 65.5    | 67.5    | 2.78                 | 2.70    | 45.8              | 48.3    | 23.8                               | 24.4    | 1.55                         | 1.59    | 152.3                 | 153.0   | 1590                              | 1690    | 24.8              | 25.9    |  |
| Udai               | 2.24    | 2.37    | 68.1    | 68.8    | 2.82                 | 2.70    | 44.6              | 48.4    | 24.2                               | 25.8    | 1.67                         | 1.70    | 161.2                 | 161.7   | 1633                              | 1862    | 24.6              | 26.4    |  |
| Awarodi            | 2.28    | 2.56    | 69.3    | 66.9    | 2.87                 | 2.94    | 46.6              | 50.3    | 25.1                               | 26.8    | 1.82                         | 1.82    | 160.3                 | 161.3   | 1829                              | 1996    | 24.7              | 26.6    |  |
| S.Em. ±            | 0.04    | 0.02    | 1.2     | 1.0     | 0.01                 | 0.01    | 0.1               | 0.4     | 0.2                                | 0.2     | 0.50                         | 0.51    | 0.4                   | 0.3     | 20                                | 32      | 0.2               | 0.3     |  |
| C.D. 5%            | 0.10    | 0.06    | 3.5     | NS      | 0.04                 | 0.2     | 0.3               | 1.1     | 0.5                                | 0.5     | NS                           | NS      | 1.2                   | 0.9     | 58                                | 95      | NS                | NS      |  |

\*NRA - Nitrate Reductase Activity ( $\mu$  mole  $\text{NO}_2^-$  produced  $\text{g}^{-1}$  fw.  $\text{hr}^{-1}$ ) at 50% flowering stage.

\*RWC - Relative Water Content (%) in leaves at 50% flowering stage.

\*Chlorophyll content in  $\text{mg g}^{-1}$  fresh weight at 50% flowering stage.

**Table 2.** Effect of urea spray x genotypes interaction on the performance of rainfed chickpea.

| Genotypes   | 2005-06                      |       |         |       | 2006-07                      |       |         |       |
|---|------------------------------|-------|---------|-------|------------------------------|-------|---------|-------|
|   | Concentrations of urea spray |       |         |       | Concentrations of urea spray |       |         |       |
|   | Control                      | 0.25% | 0.50%   | 1.00% | Control                      | 0.25% | 0.50%   | 1.00% |
| Nitrate Reductase Activity ( $\mu$ mole $\text{NO}^{-2}$ produced g-1 fw.hr <sup>-1</sup> ) |                              |       |         |       |                              |       |         |       |
| KDG-1168  | 1.84                         | 2.01  | 1.82    | 2.29  | 2.01                         | 2.43  | 2.50    | 2.35  |
| Udai  | 1.86                         | 2.12  | 2.08    | 2.90  | 2.07                         | 2.32  | 2.09    | 3.00  |
| Awarodhi  | 2.26                         | 1.84  | 2.22    | 2.80  | 2.47                         | 2.49  | 2.50    | 2.80  |
| Significant   | S.Em. $\pm$                  | 0.07  | C.D. 5% | 0.21  | S.Em. $\pm$                  | 0.04  | C.D. 5% | 0.13  |
| Relative water content in leaves (%)  |                              |       |         |       |                              |       |         |       |
| KDG-1168  | 63.0                         | 64.0  | 65.0    | 70.0  | 64.8                         | 65.7  | 68.3    | 71.2  |
| Udai  | 64.0                         | 67.1  | 69.5    | 72.0  | 65.3                         | 68.4  | 69.2    | 72.2  |
| Awarodhi  | 65.9                         | 66.0  | 71.3    | 74.0  | 64.9                         | 66.0  | 64.4    | 72.3  |
| Significant   | S.Em. $\pm$                  | 2.4   | C.D. 5% | 7.2   | S.Em. $\pm$                  | 2.4   | C.D. 5% | 7.0   |
| Chlorophyll content in leaves ( $\text{mg}^{-1}$ fresh weight)                              |                              |       |         |       |                              |       |         |       |
| KDG-1168  | 2.50                         | 2.91  | 2.81    | 2.92  | 2.59                         | 2.66  | 2.70    | 2.87  |
| Udai  | 2.67                         | 2.64  | 2.92    | 3.04  | 2.67                         | 2.35  | 2.80    | 3.00  |
| Awarodhi  | 2.83                         | 2.72  | 2.79    | 3.14  | 2.84                         | 2.95  | 2.92    | 3.05  |
| Significant   | S.Em. $\pm$                  | 0.03  | C.D. 5% | 0.09  | S.Em. $\pm$                  | 0.02  | C.D. 5% | 0.04  |
| Plant height (cm)   |                              |       |         |       |                              |       |         |       |
| KDG-1168  | 46.0                         | 45.9  | 45.0    | 46.2  | 45.0                         | 48.8  | 48.6    | 50.8  |
| Udai  | 46.5                         | 46.8  | 42.0    | 43.0  | 50.5                         | 48.6  | 47.6    | 46.9  |
| Awarodhi  | 44.3                         | 46.4  | 48.2    | 47.6  | 47.3                         | 49.4  | 52.7    | 51.7  |
| Significant   | S.Em. $\pm$                  | 0.2   | C.D. 5% | 0.6   | S.Em. $\pm$                  | 0.8   | C.D. 5% | 2.3   |
| No. of branches plant <sup>-1</sup>   |                              |       |         |       |                              |       |         |       |
| KDG-1168  | 22.0                         | 23.5  | 24.7    | 25.0  | 22.8                         | 24.0  | 24.9    | 26.0  |
| Udai  | 24.0                         | 23.3  | 26.0    | 23.5  | 25.0                         | 24.8  | 27.5    | 25.8  |
| Awarodhi  | 24.0                         | 26.8  | 27.0    | 22.8  | 26.8                         | 27.5  | 28.7    | 24.3  |
| Significant   | S.Em. $\pm$                  | 0.4   | C.D. 5% | 1.0   | S.Em. $\pm$                  | 0.4   | C.D. 5% | 1.1   |

interaction was found significant on NRA, RWC, Chlorophyll content, plant height and number of branches plant<sup>-1</sup> during both years (Table 2). NRA was recorded maximum with 1% with urea concentrations in all the three genotypes but rate of increase from control was much higher in genotype 'Udai' followed by 'Awarodi' during first year. In second year, 'KGD-1168' recorded maximum NRA with 0.5% urea concentrations while other two genotypes with 1.0% urea concentration. However, the combination of 'Udai' x 1% urea spray attained higher NRA, values. Relative water content of 'KGD-1168' was not influenced significantly by different concentrations of urea spray but incase of other two genotypes, 1% urea recorded maximum RWC which

was significantly higher only over control during both years. Chlorophyll content in leaves was recorded significantly maximum under combined effect of 'Awarodi' x 1% urea spray. Plant height of genotypes 'Udai' reduced significantly with higher urea concentrations of 0.5 and 1.0% while 'Awarodi' produced significantly taller plants with spray of 0.5% urea solution. Genotypes 'KGD-1168' produced tallest plants with 1% urea concentrations. It indicates that genotypes 'Udai' is sensitive to higher concentrations of urea spray. The combination of 'Awarodi' x 0.5% urea spray maintained significantly tallest plants in both years. Number of branches plant<sup>-1</sup> reduced increased significantly with increasing urea concentration upto

1% in 'KGD-1168' upto 0.5% in 'udai' and upto 0.25% in 'Awarodi'. In genotypes 'Udai' and 'Awarodi', number of branches plant<sup>-1</sup> reduced significantly at highest concentration of 1% urea solution. The combination of 'Awarodi' x 0.5% urea produced significantly maximum number of branches plant<sup>-1</sup> and yielded maximum at 1% of urea spray. This is in conformity with the results obtained by Rana *et al.* (1998) and Kushwaha (1994).

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