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## Water requirement of groundnut under different intercropping system and WUE in groundnut equivalent rate

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#### Abstract

An investigation on “Water requirement of groundnut under different intercropping system and WUE in groundnut equivalent rate” was carried out at Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore, during winter 2016 and summer 2017. *Arachis hypogaea* intercropped with red gram (*Cajanus cajan*), maize (*Zea mays*) and castor (*Ricinus communis*) at different irrigation levels. The groundnut equivalent yield WUE was more under intercropping treatments C<sub>3</sub> (groundnut with maize) and it was par with C<sub>2</sub> (groundnut + red gram). Under 400mm of irrigation water in addition to sprout and life irrigation, it is possible to harvest 11.34 kg of groundnut yield equivalent during winter under groundnut + maize inter cropping system, while the value was 10.71 for summer season. This groundnut + maize intercropping system were followed by ground nut + red gram in giving higher groundnut yield equivalent water use.

**Keywords:** Microclimate, groundnut, harvest, irrigation, cropping system, yield

#### Introduction

Groundnut is the most important commercial crop and also king of oilseeds grown in India. Wider spacing of groundnut allows cultivating intercrops like red gram, castor and maize for increasing the yield and productivity of crop and land. Intercropping provides an opportunity to avoid crop competition and advantages of increased production (Rahman, 1999 and Mondal *et al.*, 1999) [7, 6] and greater profit margin (Evans, 1960; Grimes, 1963) [1, 2] and gives higher resource use efficiency (Hashem and Moniruzzaman, 1986) [3].

Groundnut is widely cultivated as rainfed but it also grown as irrigated crop. Among various factors responsible for low productivity of groundnut in India, improper scheduling of irrigation is plays a vital role. Hence the needs of groundnut yield also increased by proper irrigation scheduling. Taking into account, the present study was conducted to find out the Water requirement of groundnut with different intercrops and WUE in groundnut equivalent rate.

#### Materials and method

Experiments were conducted, during winter 2016 (Aug – Dec) and summer 2017(Feb – Jun) at Tamil Nadu Agricultural University, Coimbatore to study the effect of Water requirement of groundnut under different intercropping system and WUE in groundnut equivalent rate. The field is located at 11°83' N latitude and 76°71'E longitude at an elevation of 426.7 m above mean sea level (msl) in the Western Agro Climatic Zone of Tamil Nadu.

Field experiment were carried out under irrigated conditions laid out in split-plot design with 4 levels of irrigation in main-plot *viz.*, I<sub>1</sub> = 0.7 IW /CPE ratio, I<sub>2</sub> = 0.6 IW /CPE ratio, I<sub>3</sub> = 0.5 IW /CPE ratio and I<sub>4</sub> = 0.4 IW /CPE ratio and 4 cropping systems in sub-plot *viz.*, C<sub>1</sub> - sole groundnut, C<sub>2</sub> – groundnut + red gram, C<sub>3</sub> - groundnut + maize and C<sub>4</sub> – groundnut + castor at 4:1 row ratio with three replication. The spacing adopted for groundnut was 30 cm x10 cm and intercrop 4:1 ratio Groundnut VRI 2, Red gram CO Rg 7, Maize CO 6, Castor DCH 519 Water use efficiency, groundnut equivalent yield (kg ha<sup>-1</sup>) and groundnut equivalent yield water use efficiency (kg ha<sup>-1</sup> mm<sup>-1</sup>) was analysed using the following equations,

**Groundnut Equivalent Yield (kg ha<sup>-1</sup>)**

|                            |   |   |   |   |
|----------------------------|---|---|---|---|
| Groundnut equivalent yield | = | Yield of groundnut in intercropping system (kg ha <sup>-1</sup> ) | + | $\frac{\text{Yield of intercrop kg ha}^{-1} \times \text{Market price of intercrop (Rs kg}^{-1})}{\text{Market price of groundnut (Rs kg}^{-1})}$ |
|----------------------------|---|---|---|---|

**Groundnut equivalent yield water use efficiency (kg ha<sup>-1</sup> mm<sup>-1</sup>)**

$$\text{WUE (kg ha}^{-1} \text{ mm}^{-1}) = \frac{\text{Yield of groundnut equivalent yield (kg ha}^{-1})}{\text{Total of water used (mm)}}$$

**Results and discussion**

In winter 2016, the mean data on groundnut equivalent yield (kg ha<sup>-1</sup>) and groundnut equivalent yield WUE (kg ha<sup>-1</sup>mm<sup>-1</sup>) showed that the I<sub>1</sub> recorded significantly higher value compared to other treatments. With respect to intercropping system, the groundnut equivalent yield WUE was higher (11.34) under C<sub>3</sub> (groundnut + maize) but it was par with C<sub>2</sub> (groundnut + red gram) (11.15) and the similar observation was recorded during winter 2016 and summer 2017. Least groundnut equivalent yield WUE was registered with sole crop of groundnut. Similar observations were made by Sambathkumar *et al.*, (2010)<sup>[8]</sup>.

Different irrigation level exerted significant effect on groundnut equivalent yield (Table.1 and 2). Among the irrigation levels, I<sub>1</sub> was recorded higher groundnut equivalent yield (3319 winter and 3099 summer)

Between intercropping treatments the groundnut equivalent yield was significantly higher with the treatment C<sub>3</sub> and which was on par with C<sub>2</sub>. The percentage increase in groundnut equivalent yield under C<sub>3</sub> and C<sub>2</sub> treatments over C<sub>1</sub> treatment (sole groundnut) was 150 per and 148 per cent respectively. Between the irrigation levels significant superiority of the I<sub>1</sub> level was observed, while other levels (I<sub>2</sub>, I<sub>3</sub> and I<sub>4</sub>) were at par. From the results of intercropping treatments, the C<sub>3</sub> and C<sub>4</sub> were at par in showing significantly higher groundnut

equivalent yield. Least was noticed with sole crop of groundnut (C<sub>1</sub>). The difference between levels of irrigation and between levels of intercropping treatments was alone significant. Among the irrigation levels, independent superiority of the level I<sub>4</sub> was observed in highlighting higher groundnut equivalent yield WUE (kg ha<sup>-1</sup> mm<sup>-1</sup>) followed by I<sub>3</sub>, I<sub>2</sub> and I<sub>1</sub>. Among the intercropping treatments, both C<sub>3</sub> and C<sub>2</sub> were at par as compared to other levels. C<sub>4</sub> and C<sub>1</sub> in exhibiting higher groundnut equivalent yield WUE (kg ha<sup>-1</sup> mm<sup>-1</sup>) significantly. It was found from the result that under 400mm of irrigation water in addition to sprout and life irrigation, it is possible to harvest 11.34 kg of groundnut yield equivalent during winter under groundnut + maize intercropping system, while the value was 10.71 for summer season. This groundnut + maize intercropping system was followed by groundnut + red gram in giving higher groundnut yield equivalent water use. These two systems were superior to sole groundnut treatment in respect of water use efficiency. It is interpreted from the present study that against raising a sole crop of a crop species, raising different species under intercropping would enhance water productivity irrespective of the season of study. Hebbar *et al.*, (2004)<sup>[4]</sup>; Vijayalakshmi *et al.*, (2011)<sup>[9]</sup> and Mathukia *et al.*, (2014)<sup>[5]</sup> also reported higher water use efficiency of intercropping system against sole cropping in groundnut.



**Tables**

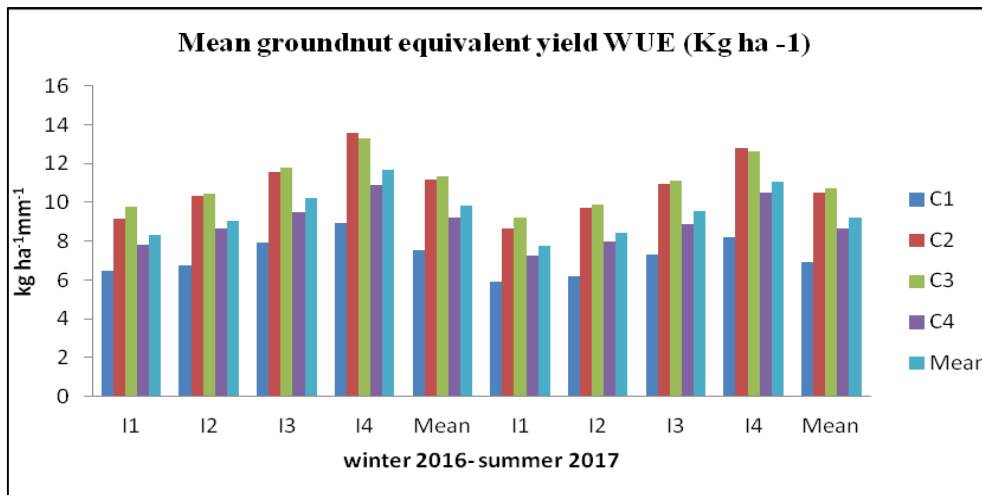
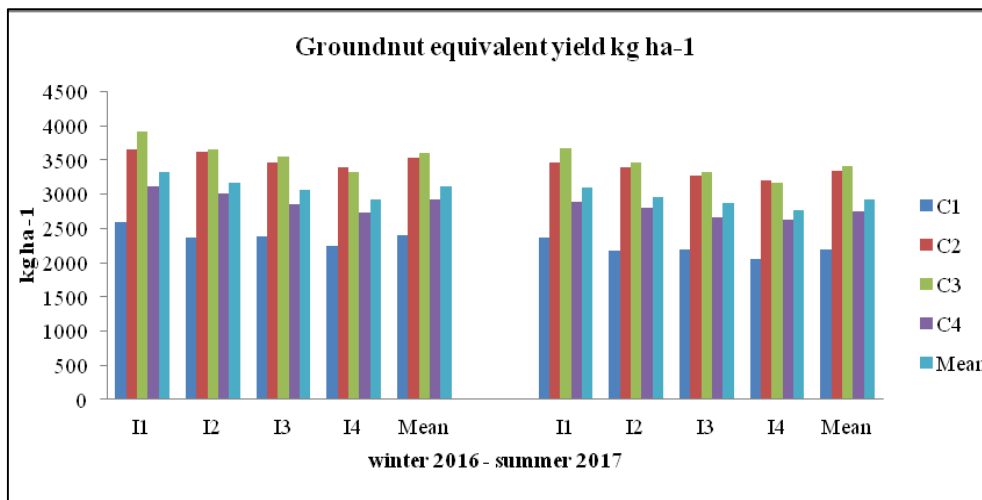
**Table 1:** Mean groundnut equivalent yield (kg ha<sup>-1</sup>) and Mean groundnut equivalent yield WUE (Kg ha<sup>-1</sup>mm<sup>-1</sup>) of groundnut as influenced by different irrigation schedules and intercropping (winter 2016)

| Treatment      | Mean groundnut equivalent yield (kg ha <sup>-1</sup> ) |                |                |                |         | Mean groundnut equivalent yield WUE (Kg ha <sup>-1</sup> ) |                |                |                |       |
|----------------|--|----------------|----------------|----------------|---------|--|----------------|----------------|----------------|-------|
|                | I <sub>1</sub>   | I <sub>2</sub> | I <sub>3</sub> | I <sub>4</sub> | Mean    | I <sub>1</sub>   | I <sub>2</sub> | I <sub>3</sub> | I <sub>4</sub> | Mean  |
| C <sub>1</sub> | 2588   | 2365           | 2384.00        | 2239.00        | 2394.00 | 6.47   | 6.76           | 7.95           | 8.96           | 7.53  |
| C <sub>2</sub> | 3655.60  | 3615           | 3470.30        | 3394.58        | 3533.88 | 9.14   | 10.33          | 11.57          | 13.58          | 11.15 |
| C <sub>3</sub> | 3919.37  | 3664.73        | 3543.60        | 3321.45        | 3612.29 | 9.80   | 10.47          | 11.81          | 13.29          | 11.34 |
| C <sub>4</sub> | 3116.65  | 3018.92        | 2852.69        | 2726.66        | 2928.73 | 7.79   | 8.63           | 9.51           | 10.91          | 9.21  |
| Mean           | 3319.90  | 3165.92        | 3062.65        | 2920.42        | 3117.22 | 8.30   | 9.05           | 10.21          | 11.68          | 9.81  |
|                | SEd  |                | CD (P=0.05)    |                |         | SEd  |                | CD (P=0.05)    |                |       |
| C              | 82.44  |                | 201.72         |                |         | 0.27   |                | 0.65           |                |       |
| I              | 65.75  |                | 135.71         |                |         | 0.21   |                | 0.44           |                |       |
| C at I         | 140.59   |                | NS             |                |         | 0.46   |                | NS             |                |       |
| I at C         | 131.51   |                | NS             |                |         | 0.43   |                | NS             |                |       |

**Table 2:** Mean value of groundnut equivalent yield and of groundnut as influenced by different irrigation schedules and Intercropping (summer 2017).

| Treatment      | Mean groundnut Equivalent Yield kg ha <sup>-1</sup> |                |                |                |         | Mean groundnut yield alone WUE Kg ha <sup>-1</sup> |                |                |                |       |
|----------------|---|----------------|----------------|----------------|---------|--|----------------|----------------|----------------|-------|
|                | I <sub>1</sub>                                      | I <sub>2</sub> | I <sub>3</sub> | I <sub>4</sub> | Mean    | I <sub>1</sub>                                     | I <sub>2</sub> | I <sub>3</sub> | I <sub>4</sub> | Mean  |
| C <sub>1</sub> | 2374.00   | 2170.00        | 2186.88        | 2054.00        | 2196.22 | 5.94   | 6.20           | 7.29           | 8.22           | 6.91  |
| C <sub>2</sub> | 3457.10   | 3401.40        | 3277.20        | 3202.90        | 3334.65 | 8.64   | 9.72           | 10.92          | 12.81          | 10.52 |
| C <sub>3</sub> | 3676.10   | 3462.30        | 3331.70        | 3163.10        | 3408.30 | 9.19   | 9.89           | 11.11          | 12.65          | 10.71 |
| C <sub>4</sub> | 2891.70   | 2796.40        | 2664.40        | 2620.70        | 2743.30 | 7.23   | 7.99           | 8.88           | 10.48          | 8.65  |
| Mean           | 3099.73   | 2957.53        | 2865.05        | 2760.18        | 2920.62 | 7.75   | 8.45           | 9.55           | 11.04          | 9.20  |
|                | SEd   |                | CD (P=0.05)    |                |         | SEd  |                | CD (P=0.05)    |                |       |
| C              | 77.24   |                | 189.00         |                |         | 0.25   |                | 0.61           |                |       |
| I              | 61.49   |                | 126.92         |                |         | 0.20   |                | 0.41           |                |       |
| C at I         | 131.57  |                | NS             |                |         | 0.43   |                | NS             |                |       |
| I at C         | 122.99  |                | NS             |                |         | 0.40   |                | NS             |                |       |

|                |   |                      |                |   |                  |
|----------------|---|----------------------|----------------|---|------------------|
| C <sub>1</sub> | : | Groundnut            | I <sub>1</sub> | : | IW/CPE ratio 0.7 |
| C <sub>2</sub> | : | Groundnut + Red gram | I <sub>2</sub> | : | IW/CPE ratio 0.6 |
| C <sub>3</sub> | : | Groundnut + Maize    | I <sub>3</sub> | : | IW/CPE ratio 0.5 |
| C <sub>4</sub> | : | Groundnut + Castor   | I <sub>4</sub> | : | IW/CPE ratio 0.4 |



**Conclusion**

Yield components of groundnut were more under I<sub>1</sub>C<sub>1</sub> irrigation treatment and under intercropping treatments, it was more under I<sub>1</sub>C<sub>1</sub> treatment during winter and same was observed during summer season also. The reduction in yield under C<sub>2</sub> C<sub>3</sub> and C<sub>4</sub> was 8, 9 and 14 per cent during winter, while it was 8, 9 and 14 per cent during summer for C<sub>2</sub>, C<sub>3</sub> and C<sub>4</sub> respectively. Though groundnut yield was affected when intercrops were introduced, the groundnut yield equivalent was higher under intercropping situation. The

groundnut equivalent yield WUE was more under intercropping treatment of groundnut with maize and it was par with groundnut + red gram and the similar trend was observed both during winter 2016 and summer 2017.

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