

# PERFORMANCE EVALUATION OF SPRINKLER IRRIGATION SYSTEM IN GANDERBAL DISTRICT J&K STATE

## ABSTRACT

Field experiments were carried at Krishi Vigyan Kendra (KVK), Shuhama (Jammu and Kashmir) to study the performance evaluation of sprinkler system. The climatic conditions of previous years were obtained and were taken into consideration before the starting of the experiment. The climatic conditions recorded for the experiment were wind speed and wind direction. The micro sprinkler arrangement was made of two types – point arrangement and linear arrangement. The volume of water was collected in water containers, systematically leveled on the ground surface and placed 0.75 x 0.75 m apart. The volume of water was measured by the aid of measuring cylinder. The water flow pressure for the experiment was kept 1.5 Kg/cm<sup>2</sup> and 2.0 Kg/cm<sup>2</sup>. The pressure was measured by a pressure gauge. The riser height was kept 0.75 m and 1 m respectively. The data revealed that uniformity coefficient varied from 82.83 to 88.7 percent in point arrangement of micro sprinklers, whereas uniformity coefficient varied from 86.10 to 91.76 percent in case of the linear arrangement of sprinklers. Experiments revealed that the change in riser height and operating pressure affected the uniformity coefficient significantly. Data also revealed that wind velocity was found to be low in the morning as compared to evening. However, wind velocity didn't show a significant effect on uniformity coefficient as wind velocity was found to be very low in the experimental area.

## 1. Introduction

Water is the most vital natural resources for the survival of human being. There is same amount of water on earth today as there was when the earth was formed. However, with increase in human and cattle population, the demand for food fiber and fodder has been increasing. As a result, water resources are progressively getting exhausted and competition for available water between agriculture, the domestic and industrial sectors is increasing day by day. [1] Irrigation is a crucial input for the development of agriculture and the importance of irrigation statistics in modernization and revolutionization of agriculture can hardly be underestimated.[2]

In the global scenario, the demand for water has been on the increase from all fronts,

33 whether be it agriculture, industry or municipal use. To increase the production of  
34 crops for feeding the world population of about six billion with dwindling water  
35 resources is a challenge. [3] The conventional method of irrigation has not been as  
36 efficient in the use of water thus resulting in excessive wastage besides creation of  
37 problems in many regions through waterlogging and salinity. Unscientific use of water  
38 apart from wastage has an injurious effect on soil health. [4] Therefore, judicious use  
39 of water is vital to achieve higher productivity in a sustainable manner. The modern  
40 systems of irrigation like drip, sprinkler coupled with other improved water  
41 management practices enhance the water use efficiency and productivity. [5] The  
42 method of applying water above the ground surface somewhat resembling rainfall is  
43 known as a sprinkler system.

44         The basic aim of the sprinkler irrigation method is to apply water uniformly as  
45 possible to the root zone. Sprinkling, as a method, has been used for many years in  
46 different parts of the world for the irrigation of nurseries, vegetables and special  
47 crops.[6] They are placed on a relatively close rectangular or triangular spacings for  
48 the maximum overlap to irrigate potatoes, carrots, leafy vegetables, groundnuts and  
49 other densely planted field crops. The sprinkler irrigation method can be used on lands  
50 with irregular topography and is well adapted to light application of water for  
51 purposes of seedbed preparation, seed germination and transplanting of  
52 seedlings.[7].Irrigation by sprinkling can be adapted to all types of soils.. The  
53 quickness with which the equipment can be transported and installed, as well as the  
54 possibility of irrigating without any special land preparation, are features which make  
55 irrigation by sprinkling attractive for this purpose.

56         In view of the fact that micro-irrigation systems including sprinkler have not

57 been popularized in Jammu and Kashmir and not enough work has been done on the  
58 performance evaluation of Sprinkler system in Jammu and Kashmir. Given the  
59 importance of the sprinkler irrigation system and its popularity, the present study was  
60 taken to study the feasibility of the sprinkler system and effect of various operating  
61 parameters on the system performance.

## 62       **2. Materials and Methods:**

63       The experiment was conducted at the Krishi Vigyan Kendra (KVK), Shuhama  
64 which is situated in district Ganderbal. The experiment site is located at an altitude of  
65 1730 m above the sea level and the region falls in the temperate zone. The  
66 experimental site has a longitude of 34.04 degree North and latitude of 74 degree  
67 south.

68       The micro sprinkler components manufactured by Jain irrigations were used for  
69 the experiment along with water containers. The main features of the given system are  
70 as under.

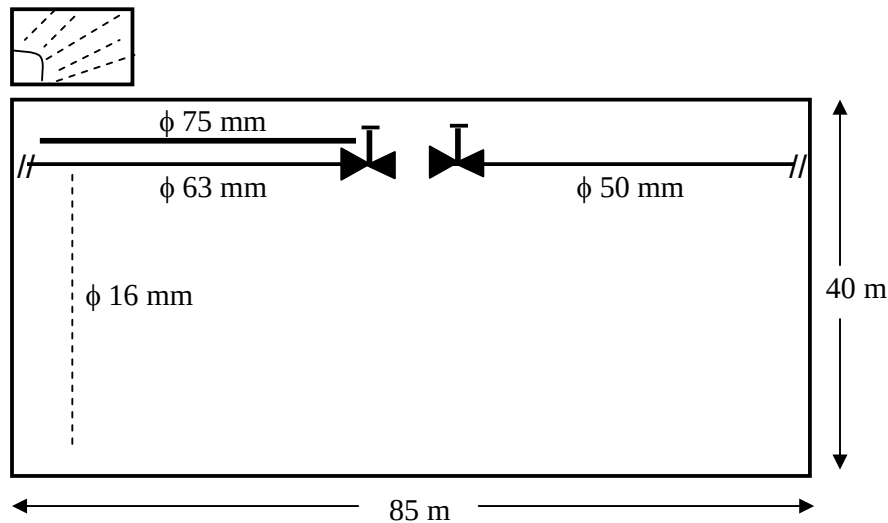
|    |              |   |                                       |
|----|--------------|---|---------------------------------------|
| 71 | Crop         | : | Vegetables                            |
| 72 | Area         | : | 40 x 85 m                             |
| 73 | Spacing      | : | 4.5 x 4.5 m (sprinkler )              |
| 74 | Water source | : | Water tank                            |
| 75 | Mains        | : | PVC pipe 75 mm x 4 kg/cm <sup>2</sup> |
| 76 | Sub-mains    | : | PVC pipe 63 x 4 kg/cm <sup>2</sup>    |
| 77 | Laterals     | : | Polytube 16 mm.                       |

78 Discharge : 69 liters/hour

79 The layout of Micro Sprinkler Irrigation System Project at 'KVK' Shuhama is illustrated in  
80 fig 1.

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84 **Fig 1. Layout of Micro Sprinkler Irrigation System Project at 'KVK' Ganderbal**

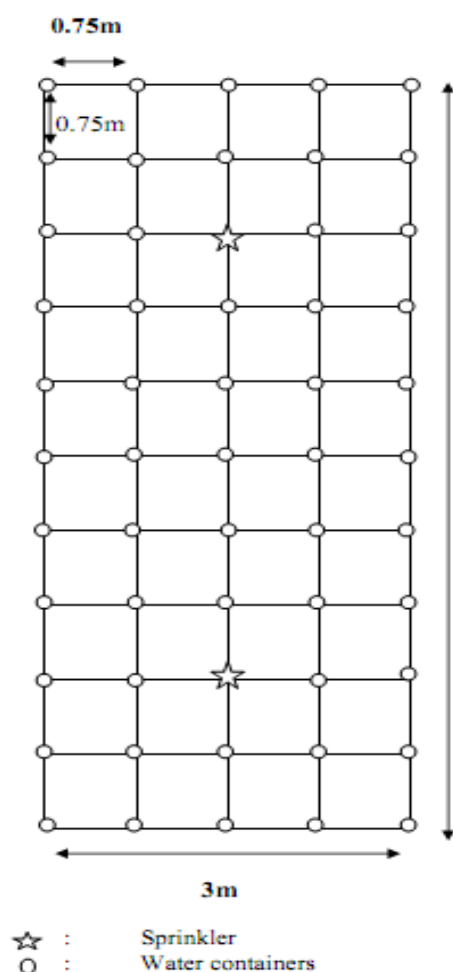
85 Water containers were used for collecting the discharge from the micro sprinkler in  
86 such a way that loss of water because of splashing was avoided. The uniformity  
87 coefficient was calculated on two arrangements namely, point arrangement (**Fig 2**)  
88 and linear arrangement (**Fig 3**). There were 34 water containers used in point  
89 arrangement where as 53 water containers were used in linear arrangement. The water  
90 containers were placed in 0.75 m x 0.75 m grid. The uniformity coefficients were  
91 calculated with the help of Christiansen (1942) formula,

92

$$C_u = 100 \left[ 1 - \frac{\sum x}{mn} \right]$$

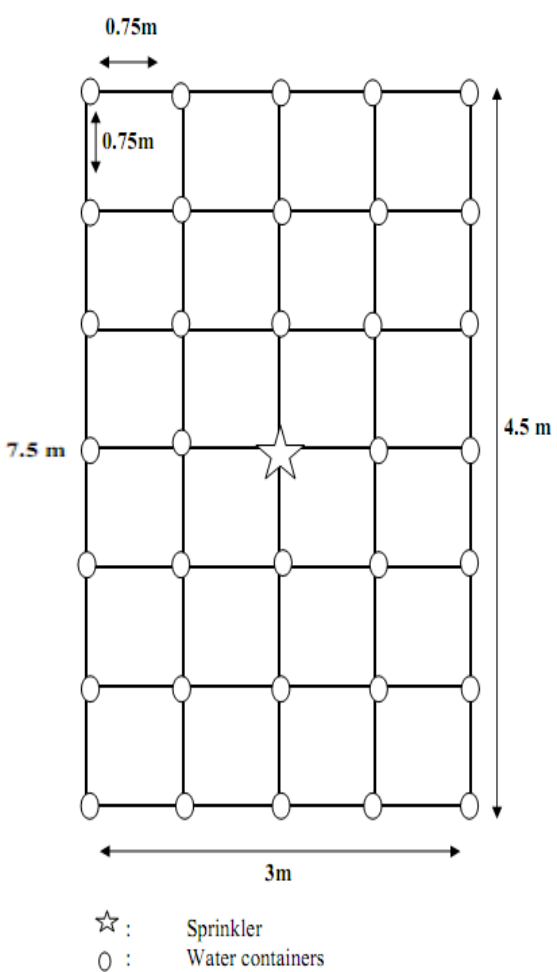
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94           A pressure gauge, having a range of 0-7 kg/cm<sup>2</sup>, was used to measure the  
95 pressure developed in the lateral line. The system was run at two different pressures,  
96 1.5 and 2 kg/cm<sup>2</sup>. Uniformity coefficient was also calculated on two different riser  
97 heights of 0.75 m and 1 m.



98

99           **Fig 2** Layout of linear arrangement of  
100           micro sprinkler



101           **Fig 3** Layout of point arrangement of  
102           micro sprinkler

101 Different agro climatic factors were considered during the experiment. The different  
102 parameters recorded and analyzed were wind speed, wind direction and other weather

conditions. These data were obtained from the Division of Agronomy, SKUAST-K.

### **3. RESULTS**

#### **3.1 Effect of riser height and operating pressure**

There was a significant effect of riser height and operating pressure on the uniformity coefficient. Uniformity Coefficient increased with the decrease of riser height (from 1 to 0.75 m ) and increase of operating pressure (from 1.5 to 2 kg/cm<sup>2</sup>). The decrease in uniformity coefficient with the increase of riser height may be due to evaporation losses and drift losses. Higher uniformity was achieved at higher pressure (2 kg/cm<sup>2</sup>).

#### **3.2 Effect of wind velocity**

A unique problem for sprinkler systems is that the water application pattern is susceptible to distortion by the wind. While wind speed and direction are not controlled variables, their effect on irrigation uniformity is significant. However, in present case studies, it was found that the wind velocity remains nearly uniform. The wind velocity data of previous three years were studied and it was found that wind velocity in this particular area (Ganderbal) was found to be nearly uniform and the wind velocity was found to be very low (except in some special weather cases). With the increase in wind velocity, uniformity coefficient decreased. However, it was not significant in this particular area as the wind velocity was very low (Fig's. 4.3, 4.4 and 4.5).

**Table- 3.1 : Process variables and their levels**

| Variable name                  | levels |     |
|--------------------------------|--------|-----|
| Pressure (kg/cm <sup>2</sup> ) | 1.5    | 2.0 |

|                         |                |                |
|-------------------------|----------------|----------------|
| <b>Riser height (m)</b> | <b>1</b>       | <b>0.75</b>    |
| <b>Wind velocity</b>    | <b>Morning</b> | <b>Evening</b> |

122 **Table-3.2 : Experimental findings in point arrangement**

| <b>Expt.No</b> | <b>Pressure<br/>(kg/cm<sup>2</sup>)</b> | <b>Riser<br/>height (m)</b> | <b>Wind<br/>time</b> | <b>Wind<br/>speed<br/>(km/hr)</b> | <b>Uniformity<br/>coefficienty<br/>(%)</b> |
|----------------|-----------------------------------------|-----------------------------|----------------------|-----------------------------------|--------------------------------------------|
| <b>1</b>       | <b>1.5</b>                              | <b>1</b>                    | <b>M</b>             | <b>1.5</b>                        | <b>84.49</b>                               |
| <b>2</b>       | <b>1.5</b>                              | <b>1</b>                    | <b>E</b>             | <b>2.6</b>                        | <b>82.83</b>                               |
| <b>3</b>       | <b>1.5</b>                              | <b>0.75</b>                 | <b>M</b>             | <b>1.6</b>                        | <b>86.40</b>                               |
| <b>4</b>       | <b>1.5</b>                              | <b>0.75</b>                 | <b>E</b>             | <b>2.0</b>                        | <b>86.20</b>                               |
| <b>5</b>       | <b>2.0</b>                              | <b>1</b>                    | <b>M</b>             | <b>1.6</b>                        | <b>87.16</b>                               |
| <b>6</b>       | <b>2.0</b>                              | <b>1</b>                    | <b>E</b>             | <b>2.0</b>                        | <b>86.40</b>                               |
| <b>7</b>       | <b>2.0</b>                              | <b>0.75</b>                 | <b>M</b>             | <b>1.5</b>                        | <b>88.70</b>                               |
| <b>8</b>       | <b>2.0</b>                              | <b>0.75</b>                 | <b>E</b>             | <b>2.6</b>                        | <b>87.80</b>                               |

123 **Table-3.3 : Experimental findings in linear arrangement**

| <b>Expt.No</b> | <b>Pressure<br/>(kg/cm<sup>2</sup>)</b> | <b>Riser<br/>height (m)</b> | <b>Wind<br/>time</b> | <b>Wind<br/>speed<br/>(km/hr)</b> | <b>Uniformity<br/>coefficienty<br/>(%)</b> |
|----------------|-----------------------------------------|-----------------------------|----------------------|-----------------------------------|--------------------------------------------|
|----------------|-----------------------------------------|-----------------------------|----------------------|-----------------------------------|--------------------------------------------|

|          |            |             |          |            |              |
|----------|------------|-------------|----------|------------|--------------|
| <b>1</b> | <b>1.5</b> | <b>1</b>    | <b>M</b> | <b>1.5</b> | <b>87.94</b> |
| <b>2</b> | <b>1.5</b> | <b>1</b>    | <b>E</b> | <b>2.6</b> | <b>86.10</b> |
| <b>3</b> | <b>1.5</b> | <b>0.75</b> | <b>M</b> | <b>1.6</b> | <b>89.74</b> |
| <b>4</b> | <b>1.5</b> | <b>0.75</b> | <b>E</b> | <b>2.0</b> | <b>88.15</b> |
| <b>5</b> | <b>2.0</b> | <b>1</b>    | <b>M</b> | <b>1.6</b> | <b>90.45</b> |
| <b>6</b> | <b>2.0</b> | <b>1</b>    | <b>E</b> | <b>2.0</b> | <b>88.98</b> |
| <b>7</b> | <b>2.0</b> | <b>0.75</b> | <b>M</b> | <b>1.5</b> | <b>91.76</b> |
| <b>8</b> | <b>2.0</b> | <b>0.75</b> | <b>E</b> | <b>2.6</b> | <b>91.02</b> |

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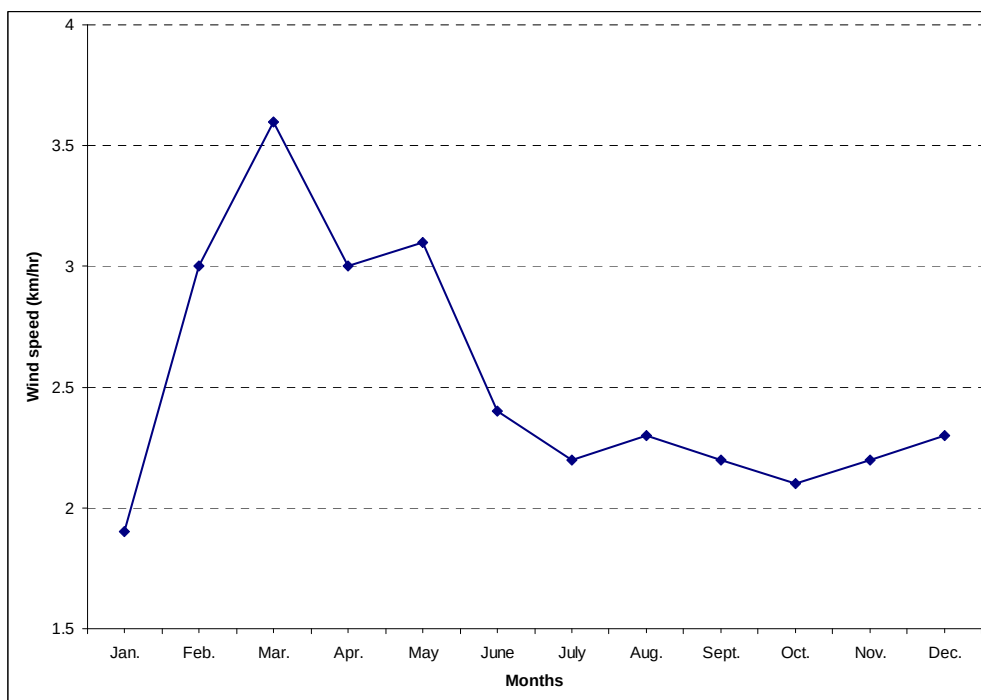


**Fig.3.4: Monthly average wind speed (km/hr) in district Ganderbal during 2014**

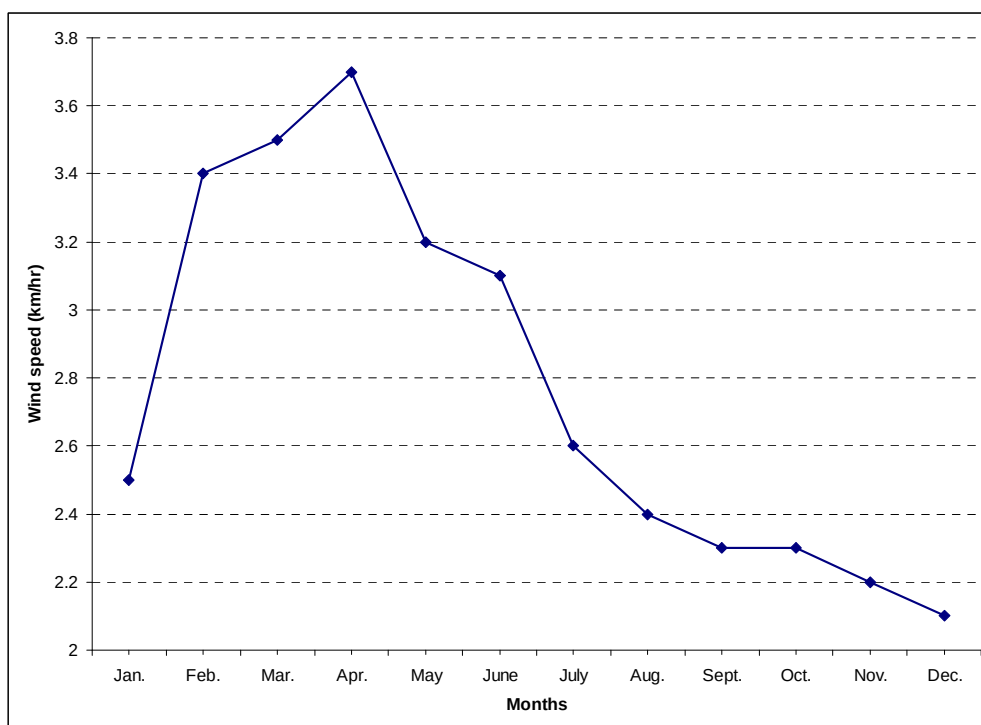


**Fig. 3.5 : Monthly average wind speed (km/hr) in district Ganderbal during 2015**

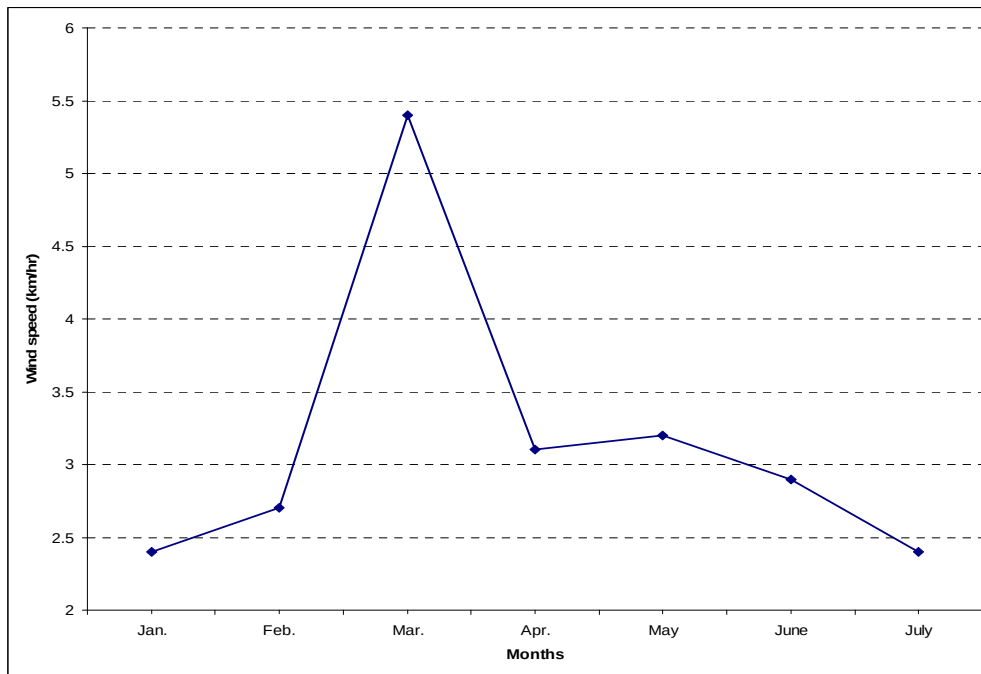


**Fig. 3.6 Monthly average wind speed (km/hr) in district Ganderbal during 2016. The month of March has shown a steep increase in curve because of wind speed recorded on 12<sup>th</sup> of March was 63.6 km/hr**

#### **4. Discussions :**

From the present studies, it was concluded that the uniformity coefficient obtained from field data was found to be **82.83** and 88.7 percent as minimum and maximum in point arrangement of micro sprinklers, whereas it varied from 86.10 and 91.76 percent in case of the linear arrangement of sprinklers.

Wind velocity during the experiment varied from 1.5 to 2.6 km/hr. Under these conditions, the effect of wind velocity on uniformity coefficient was not significant. Under present circumstances, the system can be run anytime.

Uniformity coefficient increased with the increase in operating pressure and decreased with the increase in riser height. The decrease of uniformity coefficient with the increase in riser height may be due to evaporation losses and drift losses

#### 4. CONCLUSION

Uniformity coefficients were calculated from the field data and were found to be 82.83 and 88.7 per cent as minimum and maximum in point arrangement of micro sprinklers and 86.10 and 91.76 per cent respectively, in case of linear arrangement.

There was a significant effect of riser height and operating pressure on the uniformity coefficient. Uniformity Coefficient increased with the decrease of riser height (from 1 to 0.75 m) and increase of operating pressure (from 1.5 to 2 kg/cm<sup>2</sup>). The decrease in uniformity coefficient with the increase of riser height may be due to evaporation losses and drift losses. Higher uniformity was achieved at higher pressure (2 kg/cm<sup>2</sup>).

A unique problem for sprinkler systems is that the water application pattern is susceptible to distortion by the wind. While wind speed and direction are not controlled variables, their effect on irrigation uniformity is significant. However, in present case studies, it was found that the wind velocity remained nearly uniform.

With the increase in wind velocity, uniformity coefficient decreased. However, it was not significant in this particular area as the wind velocity was very low.

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