

Phase - IV
**Status Report on Crop Kc, Water Requirement of Summer
Sesame and Summer Greengram**

“Determination of crop coefficients for major crops by Lysimetric studies”

Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

Title of the Project: Determination of crop coefficients for major crops by Lysimetric studies” at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

Location: Department of Irrigation and Drainage Engineering, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola.

Duration: Three years.

Total outlay: Rs. 38.38 lakhs.

Investigators:

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INTRODUCTION:

The Project is being executed at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. As per schedule of reporting requirements, following are the details regarding the crop coefficient of summer greengram and summer sesame also the water requirement for Summer Greengram, Summer Sesame.

DETAILS OF WORK:

Cultivation of Summer Green Gram and Summer Sesame:

As it was planned to cultivate Summer Green Gram and Summer Sesame, the sowing of summer sesame (CV- PDKV NT-11) was done on 11th February 2022 and the sowing of Greengram (CV- Pusa Vaishakhi) was done on 28th March 2022. Whereas, the harvesting of the Sesame was done on 25th May 2022 and Greengram on 3rd June 2022.

Following images shows the different field practices done during the entire growing period of Sesame and Greengram.



Sowing



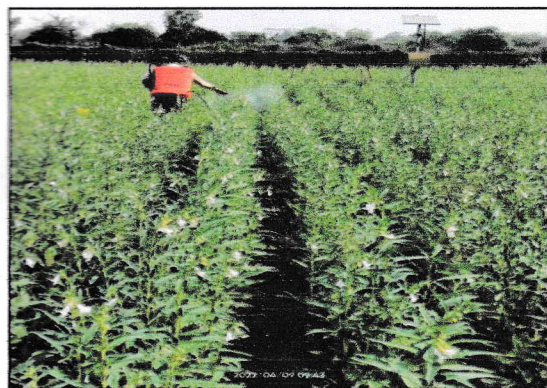
Irrigation



Germination



Thinning and Weeding



Spraying Pesticides and Insecticides



Harvesting

Cultivation of Summer Sesame



Sowing



Irrigation



Germination



Weeding



Spraying Pesticides and Insecticides



Harvesting

Cultivation of Summer Greengram

Plant Protection Measures

An unhealthy and diseased plant greatly affects the evapotranspiration of the crop. For healthy and disease free plants, the spraying of insecticides and pesticides were done at different stages of crop according its requirement. Following are the details of insecticides, fungicides and pesticides applied during the growth period for healthy growth of Sesame and Greengram.

Table 1. Plant Protection Measures in Summer Sesame

Sr. No.	Date of Application	Insecticide/ Fungicide/ Pesticide	Quantity
1	07/03/2022	Profenofos 50 % EC	15 ml/10 lit. water
2	15/03/2022	Quinalphos 25 % EC	20 ml/10 lit. water
3	21/03/2022	Azadirachtin 300 ppm 0.03 %	50 ml/ 10 lit. water
4	25/03/2022	Pyriproxyfen 10 % EC	8 ml/ 10 lit. water
5	29/03/2022	Azadirachtin 300 ppm 0.03 %	50 ml/ 10 lit. water
6	09/04/2022	Flonicamid 50 % WG	3 gm/ 10 lit. water
7	16/04/2022	Flonicamid 50 % WG	3 gm/ 10 lit. water

Table 2. Plant Protection Measures in Summer Greengram

Sr. No.	Date of Application	Weedicide/ Insecticide/ Fungicide/ Pesticide	Quantity
1	29/03/2022	Pendimethelene 38.7 % CS	40 ml/10 lit. water
2	11/04/2022	Flonicamid 50 % WG	3 gm/ 10 lit. water
3	16/04/2022	Flonicamid 50 % WG	3 gm/ 10 lit. water
4	20/04/2022	Propaquizop 10 % EC	15 ml/ 10 lit. water
5	23/04/2022	Monocrotophos 3.6 % SL	8 ml/ 10 lit. water
6	30/04/2022	Monocrotophos 3.6 % SL	8 ml/ 10 lit. water
7	03/05/2022	Propaquizop 10 % EC	20 ml/ 10 lit. water
8	14/05/2022	Chlorantraniliprole 18.5 % W/W SC	7 ml/ 10 lit. water.

Plant Growth Observations

During the process of planting and growing the crops, there were several observations made regarding growth and yield of crops. Observations were made by selecting 10 random plants from the lysimeter in different intervals i.e. for sesame at 30 days after sowing, 60 days after sowing, 90 days after sowing and at the time of harvest. Also for Greengram at 15 days interval i.e., 15 days after sowing, 30 days after sowing, 45 days after sowing and 60 days after sowing. The overall observations were focused around height of crop, number of branches, number of leaves, number of flowers, number of capsules/pods and yield. Following table illustrates an overall detail about the growth parameters of summer Sesame and summer Greengram during the growing period.

Table 3. Plant Growth Parameters and yield of Summer Sesame

Parameters (Average)	30 DAS	60 DAS	90 DAS	At Harvest
Height (cm)	18.1	65.7	92.6	107.4
Branches	3.5	4.1	4.1	4.1
Leaves	28.7	43.6	127	104.8
Flowers	0	5.5	13.5	2
Capsules	0	11	52.6	56.8
Avg. Yield				9.82 q/ha

Table 4. Plant Growth Parameters and yield of Summer Greengram

Parameters (Average)	15 DAS	30 DAS	45 DAS	60 DAS
Height (cm)	7.95	15.9	42.85	59.3
Branches	0	5	10.4	11.2
Leaves	6.4	15.75	33.55	34.8
Flowers	0	0	5.1	2.2
Pods	0	0	9.65	18.7
Avg. Yield				12.09 q/ha

Penman Monteith Method

The FAO Penman Monteith Method has been recommended as the sole standard method for calculating reference crop evapotranspiration. It is a method with strong likelihood of correctly predicting ETr in a wide range of locations (Allen et. al., 1998). By defining the reference crop as a hypothetical crop with assumed height of 0.12 m having a surface resistance of 70 s m⁻¹ and an albedo of 0.23, closely resembling the evaporation of an extensive surface of green grass of uniform height, actively growing and adequately watered the FAO Penman Monteith Method was developed as presented by following equation.

$$ET_o = \frac{0.408\Delta(R_n - G) + \gamma \left(\frac{900}{T + 273} \right) u_2 (e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)}$$

Where,

- ET_o = Reference evapotranspiration (mm day⁻¹)
- Δ = Slope of saturation vapour pressure curve (kPa °C⁻¹)
- T = Mean air temperature (°C)
- γ = Psychrometric constant (kPa °C⁻¹)
- R_n = Net radiation at the crop surface (MJ m⁻² day⁻¹)
- G = Soil heat flux density (MJ m⁻² day⁻¹)
- u₂ = Wind speed at 2.0 m height (ms⁻¹)
- e_a = Actual vapour pressure (kPa)
- e_s = Saturation vapour pressure (kPa)
- e_s - e_a = Saturation vapour pressure deficit (kPa)

CROP COEFFICIENTS (KC) FOR SUMMER GREENGRAM AND SESAME:

The weekly value of crop coefficients was computed as the ratio of weekly crop evapotranspiration and weekly reference evapotranspiration. The meteorological data like maximum temperature, minimum temperature, rainfall, wind speed, relative humidity and bright sunshine hours were taken from Agro-meteorology observatory, Department of Agronomy, Dr. PDKV, Akola. Weekly crop evapotranspiration was obtained from lysimeters by growing crop in lysimeters. For Greengram, two lysimeters was used and the crop evapotranspiration values were measured for both lysimeters and the obtained crop coefficient values was averaged over both the lysimeters to avoid errors in measurement. Whereas for Summer Sesame one lysimeter was used to measure the crop evapotranspiration to obtain the crop coefficient values. Penmen Monteith method was used to estimate the reference crop evapotranspiration. The ratio of crop

evapotranspiration and reference crop evapotranspiration is called as Crop Coefficient. Following tables represents the values of crop coefficient for summer Greengram and sesame.

Table 5. Weekly Crop Coefficient (Kc) Values for Summer Greengram

Crop Week	Weekly Kc by lysimeter 1	Weekly Kc by Lysimeter 2	Average Kc	Crop Growth Stages	Stagewise Kc Values
1	0.49	0.48	0.48	Initial (15 Days)	0.57
2	0.58	0.59	0.59		
3	0.70	0.74	0.72		
4	0.84	0.90	0.87	Deve. (25 Days)	0.96
5	0.97	1.04	1.01		
6	1.08	1.17	1.12	Mid (25 Days)	1.17
7	1.15	1.24	1.20		
8	1.17	1.26	1.21		
9	1.11	1.20	1.16	End (15 Days)	0.81
10	0.97	1.04	1.01		
11	0.73	0.77	0.75		

Table 6. Weekly Crop Coefficient (Kc) Values for Summer Sesame

Crop Week	Weekly Kc by Lysimeter	Crop Growth Stages	Stagewise Kc Values
1	0.43	Initial (20 Days)	0.54
2	0.54		
3	0.67		
4	0.80	Deve. (35 Days)	1.02
5	0.93		
6	1.05		
7	1.15		
8	1.23		
9	1.29	Mid (45 Days)	1.23
10	1.31		
11	1.31		
12	1.27		
13	1.19		
14	1.07	End (20 Days)	0.67
15	0.91		
16	0.71		
17	0.47		

The computed Kc values for Summer Greengram during initial, development, mid and end stage were 0.57, 0.96, 1.17 and 0.81 respectively and for Summer sesame were 0.54, 1.02, 1.23 and 0.67 in respective stages. The average weekly Kc values for Greengram ranges between 0.48 (Initial stage) and 1.21 (Mid stage) during the crop growth period. Whereas for Summer sesame it ranges between 0.43 (Initial stage) and 1.31 (Mid stage) during the growth period. The maximum values of crop coefficients were

estimated during the mid-stage mainly because of higher canopy. Following figures 1 and 2 represents the variation in Weekly Crop Coefficient (K_c) values during the growth period for summer Greengram and Sesame.

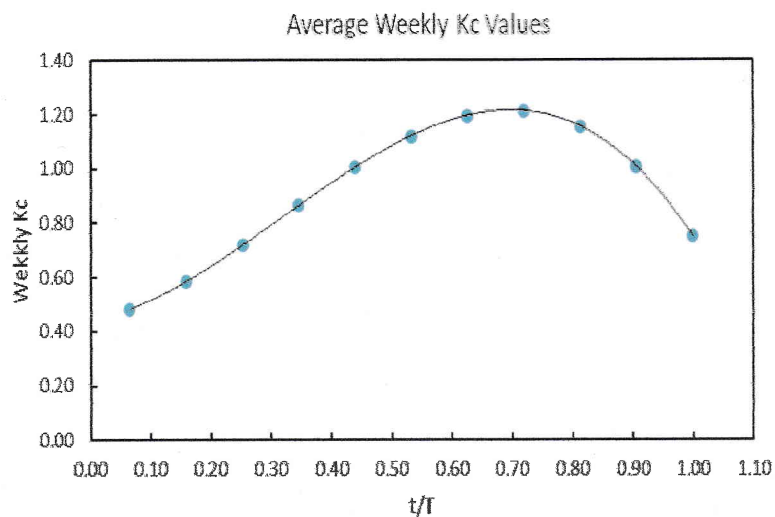


Figure 1. Weekly Crop Coefficient Values for Summer Greengram

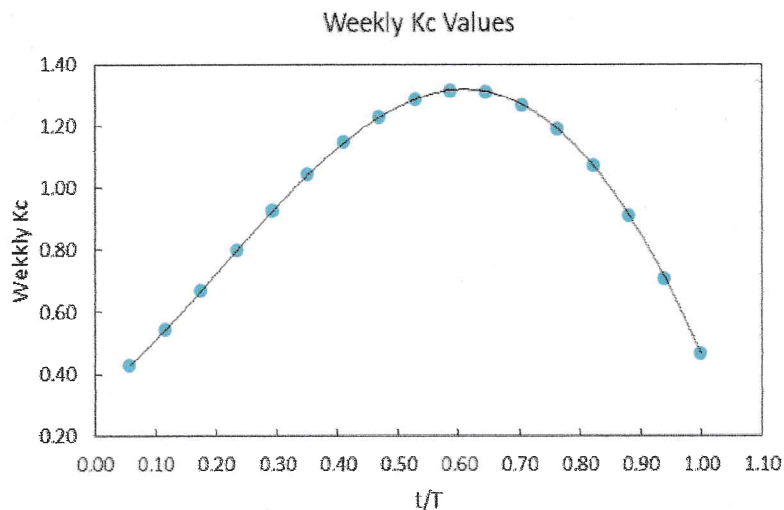


Figure 2. Weekly Crop Coefficient Values for Summer Sesame

Water Requirement for summer sesame and summer Greengram Crops:

Taluka wise crop water requirement (mm/day) was determined using Lysimetric Kc values obtained for summer greengram and summer sesame by ignoring the effective rainfall for all districts and talukas in Vidarbha region. Also the irrigation water requirement was determined by considering the crop water requirement at different irrigation efficiencies. It was calculated for surface irrigation at 40%, 50% and 60% irrigation efficiency, for drip irrigation at 90% and 95% irrigation efficiency and for sprinkler irrigation at 80% and 85% irrigation efficiency. The taluka wise and district wise water requirement for summer greengram and summer sesame are given in Annexure I and II respectively for above mentioned irrigation efficiencies.



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