CHAPTER VI

SUMMARY AND CONCLUSION
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Cultivation of sunflower is recent attraction of growers because of its high yield potential and market value. Now acreage under sunflower is spreading widely particularly under irrigated conditions in Satpura plateau zone of Madhya Pradesh. Thus, efficient water management technology needs to be identified for obtaining the substantial productivity of this valuable non-conventional crop. The present investigation was aimed to determined the proper irrigation schedule of sunflower on the basis of different approaches like physiological stages of crop or IW/CPE ratio or depletion of soil moisture pattern for improving the water use efficiency and economizing the irrigation water.

The field experiments were conducted during Rabi season of 1995-96 and 1996-97 at Research Farm, Agronomy Department, J.N. Agricultural University, Jabalpur (M.P.). The soil of the experimental field was clay loam in texture and neutral (soil pH 7.50) in reaction. The field capacity and wilting point of the soil at 0-15 cm depth were 33.60 and 20.11% respectively. The soil was poor in organic carbon content (0.58 %) with normal electrical conductivity (0.18 dSm⁻¹). It had low available N. (228 Kg/ha.) and P (7.87 Kg/ha.) and high available K (351 Kg/ha.). There was 214.8 mm and
67.8 mm rainfall during the crop season (October to March) in the two consecutive years.

Twelve treatments consist of irrigation schedules each with 3 approaches of scheduling irrigation viz. based on soil moisture depletion as 20, 30, 40 and 50%, based on IW/CPE ratio as 1.0, 0.8, 0.6 and 0.4 and based on phenological growth stages as no stress (irrigation at all important growth stages), stress at 8-9 leaf, stress at flowering and stress at grain filling were tested in randomized block design with four replications. Crop cv. ‘Morden’ was sown on November 12, 1995 and November 16, 1996 in 50 cm x 20 cm planting geometry. A uniform dose of 80 kg N + 60 kg P₂O₅ + 40 kg K₂O/ha was applied to all treatments.

In case when 2 or 3 irrigation were given, half N and full P and K was applied as basal and rest half N was applied just after first irrigation. In case when only one irrigation was given mainly advanced growth stage of crop, full dose of all fertilizers was given as basal.

Different observations on morphological characters (plant-height, stem-girth, leaves/plant), physiological characters (LAI, DM production, CGR, RGR, NAR), seed and haulm yields, oil content and oil yield, consumptive use of water (CUW) and water use efficiency (WUE), economics of the treatment and nutrients (NPK)
uptake by crop were recorded. The results have focussed many
interesting findings of academic and Practical importance. The
salient features of the findings are summerised as below:

Morphological characters viz. plant-height and functional
leaves/plant orderly increased upto 75-day growth period under all
treatments and thereafter these characters decreased. But stem-
thickness and DM accumulation by the plants increased successively
till final stage of the crop.

Different irrigation schedules decided on the basis of
various approaches viz soil moisture depletion pattern, IW/CPE
ratio and physiological growth stages of the crop significantly
varied important morphological (plant-height, leaves/plant and stem-
thickness) and physiological (LAI, DM production, CGR, RGR and
NAR) characters during the second year of experimentation, but in
first year, the effects of irrigation schedules were nullified due to
sufficient rains during the entire crop season. As a whole, morphological
and physiological parameters of the crop were superior with the
highest irrigation frequency under each criterion of scheduling the
irrigation. Each decrease in irrigation frequency under all approaches
for deciding the irrigation frequency reduced these parameters.
Three irrigations at critical growth stages including 8-9 leaf, flowering
and grain development proved equally good to 4 irrigations at 1.0
IW/CPE or 20% soil moisture depletion with regards to these
growth parameters. Similarly, 2 irrigations applied at any two of the three critical growth stages also proved as good as 3 irrigations at 0.8 IW/CPE or 30% soil moisture depletion. The obvious conclusion that could be drawn from these observation that scheduling irrigations on the basis of critical growth stages was more promising for improving the crop growth than other criteria for scheduling the irrigation.

Consequence upon above facts, irrigation based on critical growth stages proved more effective in improving the yield attributes viz. head-size, number of seeds/plant, seed index, shelling percentage, chaffiness percentage, seed yield/plant which ultimately resulted to increased seed yield.

Both seed and haulm yields significantly varied due to different irrigation schedules in both years, but effects were more pronounced in the second year. Seed and haulm yields were comparable under all irrigation schedules decided on the basis of different approaches in first year except to 2 irrigations at 30 and 1 irrigation at 50% depletion of soil moisture those produced significantly lower yields than rest. The rainfall during crop season in first year deviated the effect of irrigation schedules on yields. But in second year, the minimum irrigation frequency at 50% depletion of soil moisture or at 0.4 IW/CPE produced the lowest yields which increased by increasing the irrigation frequencies as
irrigations at 20, 30 and 40% soil moisture depletion or at 1.0, 0.8 and 0.4 IW/CPE, with non-significant differences between the closer frequencies. Crop irrigated at all the three critical growth stages (8-9 leaf, flowering, grain filling) produced significantly higher seed and haulm yields which reduced by missing irrigation at either of these stages, the reduction being more by missing irrigation at 8-9 leaf or flowering stages.

Oil content in seeds did not vary due to different irrigation schedules in first year, but highest irrigation frequency resulted to more oil content in seeds, than lower irrigation frequencies with non-significant variations between the closer levels of irrigation frequencies. Increased seed yield and oil content in seeds with higher irrigation frequencies produced significantly higher oil yield than lower irrigation frequencies under all criteria for scheduling the irrigation.

Seasonal CUW was higher in first year under all treatments than second year because of rains during the crop season. Irrigation schedules did not vary CUW in first year, but it was maximum with highest frequencies in second year which reduced correspondingly by decrease in each level of irrigation frequency under all criteria for scheduling the irrigation. The WUE was inconsistent among different irrigation schedules during first year, but in second year,
crop irrigated at all critical stages resulted to higher WUE then other schedules of irrigation based on depletion of soil moisture or IW/CPE ratio.

The uptake of N in sunflower was more by haulms than seeds, while P and K uptake were higher in seeds than haulms. The N,P,K contents in seeds and haulms were unaffected by different irrigation schedules. But total uptake of these nutrients significantly varied due to irrigation schedules. Generally increased irrigation frequencies resulted to higher uptake of these nutrients by the crop because of efficient utilization of nutrients by the crop.

Crop irrigated at all critical growth stages proved to be more remunerative than irrigating it on the basis of soil moisture depletion pattern or IW/CPE ratio. Initial growth (8-9 leaf) and flowering stages of crop coincided at 30 and 55 days after sowing proved most critical stages for irrigation. Irrigating the crop at these stages proved most economically viable because of high WUE.

**Conclusions**

The above findings concluded the following points:

1. The irrigation water could be more efficiently utilized by irrigating Rabi sunflower on the basis of important physiological growth stages than that of irrigating it on the basis on soil
moisture depletion pattern or IW/CPE ratio.

2. Initial vegetative growth, flowering and grain development stages of crop proved to be critical stages for irrigation in sunflower cv, 'Modern' and initial vegetative and flowering stages of crop appeared to be most critical.

3. Growth parameters of the crop did not reduce much, if it received adequate moisture till flowering stage. Moisture stress at initial growth and at grain development stages resulted adverse effect on the crop growth.

4. Three irrigations given to sunflower at initial vegetative growth, flowering and grain development stages which normally coincided to 30, 55 and 75-day growth of crop gave maximum seed yields mainly due to improved growth characters and yield attributes. Oil yield increased with higher irrigation frequency due to increase in oil content in seeds and seed yield.

5. Application of 3 irrigations at 8-9 leaf, flowering and grain development stages proved to be more remunerative on the basis of gross and net monetary returns and benefit-cost ratio. It was equally good to 4 irrigations applied at 20 % depletion of soil moisture. In case two irrigations are available, irrigations at 8-9 leaf and flowering stages of crop were most advantageous.
Suggestions for Further Research Work

Based on the experience of the present investigation, following thrust areas for research work in future have been identified:

1. The combinations of some other factors of crop production viz. fertilizer doses and sowing dates with irrigation schedules based on critical growth stages need to be studies critically.

2. Different methods of irrigation in relation to irrigation schedules based on different approaches of scheduling irrigation should be studied for further improvement in the water use efficiency and water economy.

3. The present study requires confirmation in the light and medium textural soils.