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# Review on the Effect of Planting Time on Water use Efficiency

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**Abstract:** *Water use efficiency (WUE) is the measure of cropping system's capacity to convert water into plant biomass or grain. Vast amounts of water are transpired in comparison with the small amounts of carbon that are fixed by photosynthesis. With diminishing fresh water supplies, the threat of more frequent droughts due to climate change, and the increasing demand for more food crops, the possibility of increasing "agricultural water productivity" through agronomic and genetic means has received much attention. Although conservation agriculture, improved irrigation management, and other agronomic practices have made significant contributions to improving yields under water-limited conditions. Many species also display plasticity in their WUE; acclimating to drier conditions, but caution needs to be taken in comparing studies from different environments as differences in transpiration associated with vapor pressure deficits need to be taken into account. The objective of this paper is to review on the Effect of Planting Time on Water use Efficiency.*

**Keywords:** *Conservation Agriculture, Acclimating, Transpiration, Plant biomass,*

## 1. Introduction

Water use efficiency (WUE) is the measure of cropping system's capacity to convert water into plant biomass or grain. It includes both the use of water stored in the soil and rainfall during the growing season. Originally, crop physiologists defined water use efficiency as the amount of carbon assimilated and crop yield per unit of transpiration (Viets, 1962) and then later as the amount of biomass or marketable yield per unit of evapotranspiration.

Different definitions, dimensions, and time scales have not contributed to define a unified concept for WUE and, more importantly, a common strategy to improve it (Hsiao et al., 2007). I Different definitions, dimensions, and time scales have not contributed to define a unified concept for WUE and, more importantly, a common strategy to improve it (Hsiao et al., 2007). I Different definitions, dimensions, and time scales have not contributed to define a unified concept for WUE and, more importantly, a common strategy to improve it (Hsiao et al., 2007). I Different definitions, dimensions, and time scales have not contributed to define a unified concept for WUE and, more importantly, a common strategy to improve it (Hsiao et al., 2007). I Different definitions, dimensions, and time scales have not contributed to define a unified concept for WUE and, more importantly, a common strategy to improve it (Hsiao et al., 2007). I Different definitions, dimensions, and time scales have not contributed to define a unified concept for WUE and, more importantly, a common strategy to improve it (Hsiao et al., 2007). I Water use efficiency (WUE) is a concept introduced 100 years ago by Briggs and Shantz (1913) showing a relationship between plant productivity and water use. Vast amounts of water are transpired in comparison with the small amounts of carbon that are fixed by photosynthesis. Typical crop plants transpire 200–1,000 g of water per g of assimilated carbon (Martin et al. 1976). With diminishing fresh water supplies, the threat of more frequent droughts due to climate change, and the increasing demand for more food crops, the possibility of increasing "agricultural water productivity" through agronomic and genetic means has received much attention (Araus et al. 2008; Reynolds and Tuberosa 2008; Passioura and Angus 2010). Although conservation agriculture, improved irrigation management, and other agronomic practices have made significant contributions to improving yields under water-limited conditions (Anderson et al. 2005; Turner and Asseng 2005), genotypes that are better matched to their target environments are also needed. The ratio between these two parameters, called water use efficiency Plants that are drought tolerant or have evolved in environments with limited available water tend to have higher WUE than plants adapted to conditions with freely available water (Smith et al. 1989). Different plant species vary in their WUE (Briggs and Shantz 1913; Rawson and Begg 1977; Siddique et al. 2001). Many species also display plasticity in their WUE (Smith et al. 1989); acclimating to drier conditions, but caution needs to be taken in comparing studies from different environments as differences in transpiration associated with vapor pressure deficits need to be taken into account (Rawson and Begg 1977). Therefore the objective of this paper is to review on the Effect of Planting Time on Water use Efficiency.

## 2. Litrature Review

### 2.1 Effect of Planting Time on Water use Efficiency

Plant growth in winter and that displaces much of the growing season towards a period in the spring and early summer when water supplies are increasingly limited (Loomis, 1983).Improving the efficiency of water use in rain fed agriculture is associated with increasing the fraction of the available water resources that is transpired, be- cause of the unavoidable association between yield and water use (De Wit, 1958).

Experiments with different planting dates carried out during the 1980s (Gimenoet al., 1989) gave very good results for winter plantings, demonstrating that it was possible to increase rain fed yields by moving the planting date towards winter. As a result, farmers presently sow sunflower as soon as they can enter the field following a dry period after early February. Earlier plantings have posed practical Weed control problems in the area. Yields have generally increased over those obtained with spring plantings butitis not known what the underlying mechanisms responsible are. Time of planting is one of the most important agronomic factors for realizing the yield potential of improved varieties as it helps in achieving complete harmony between vegetative and reproductive growth stages of the crop. Planting the crop at optimum time therefore, plays a key role in obtaining high seed yields (Ihsanullah et al. 2002, Dubey and Singh 2006, Rathore et al. 2010).

Late sowing can increase severity of most root diseases early sowing increases severity of a number of leaf diseases.

**Planting too early can bring its own problems, namely,**

- The soil may be too dry for rapid establishment,
- Young plants may be at risk from diseases existing in old stubbles
- Volunteers from previous crops may not have been killed off and,
- Risk from late spring frosts

### 2.2 Factors Contributing for proper Planting Time

#### 2.2.1 Planting Depth

When planting a seed, many factors allow the seed to grow and become a plant. To sprout from the ground, and to survive, seeds need water, air, and a certain temperature. Seeds can get water, oxygen, and sun by being placed at the proper planting depth. Planting depth is the depth at which a seed is placed in the soil. If a seed is exposed to these important needs, it goes through a process called germination. The germination process begins when water and oxygen are pulled into the seed by the seed’s coating. The embryo’s cells grow bigger as water and air.

**Ideal Planting Depth**

Every seed has a unique planting depth based on its overall size. In general, a seed's planting depth is approximately two to three times its diameter size. However, there are exceptions to this rule, making it imperative to follow the planting instructions for your particular plant species. Depending on the plant, some seeds need a deep planting location so that subsequent roots grow deeply for solid anchoring. Other plant seeds need to lay on top of the soil without any coverage for successful germination. All of the seeds' preferred planting depths depend on their natural environment and evolutionary development.

**Shallow and Deep Planting Depths**

If you have clay soil that tends to harden over during the hot summer months, your best planting depth should be relatively shallow -- your seed cannot develop a seedling that pushes through the hard clay and fails to grow at all. However, any shallow plantings need to be coupled with consistent irrigation since drying winds often hinder germination or cause future stability problems for taller plants. In contrast, a deep planting may be necessary, based on the season. For example, warm soil temperatures and deep moisture levels in the autumn call for a deep planting -- the subsequent seedling reaches critical soil water supplies and avoids overheating at the surface with this strategy.

**General Guidelines for Seed Depth**

- In general, seeds should be planted at a depth of two times the width, or diameter, of the seed. For example, if you have a seed that's about 1/16 inch thick, it should be planted about 1/8 inch deep. Large bean seeds, which can be up to 1/2 inch wide, may need to be planted an inch deep.
- For tiny seeds, place them on the surface of the soil and barely cover them with soil or vermiculite.
- Don't compress the soil atop the seeds as you plant them. The soil should be firm but not compacted.

#### 2.2.2 Temperature

Responses to temperature differ among crop species throughout their life cycle and are primarily the phenological responses, i.e., stages of plant development. For each species, a defined range of maximum and minimum temperatures form the boundaries of observable growth. Vegetative development (node and leaf appearance rate) increases as temperatures rise to the species optimum level. For most plant species, vegetative development usually has a higher optimum temperature than for reproductive development. Cardinal temperature values for selected annual (non-perennial) crops are given in Hatfield et al., 2008, Hatfield et al., 2011 for different species.

#### 2.2.3. Disease,

An impairment of the normal state of a plant that interrupts or modifies its vital functions. All species of plants, wild and cultivated alike are subject to disease. Although each species is susceptible to characteristic diseases, these are, in each case, relatively few in numbers. The occurrence and prevalence of plant diseases vary from season to season, depending on the presence of the pathogen, environmental conditions, and the crops and varieties grown. Some plant varieties are particularly subject to outbreaks of diseases while others are more resistant to them.

### 2.2.4 Occurrence of Pests

A pest is an organism which harms man or his property significantly or is likely to do so (Woods, 1976). It includes insects, nematodes, mites, snails, slugs, etc. and vertebrates like rats, birds, etc. Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products [FAO, 1990; revised FAO, 1995; IPPC, 1997; revised CPM, 2012. For example seasonal pests occur during a particular season every year e.g. Red hairy caterpillar on groundnut, Mango hoppers Persistent pests.

### 2.2.5 Soil Moisture content

Soil moisture is a key variable in the climate system. By controlling evapotranspiration,

Soil moisture impacts the partitioning of incoming radiation into sensible and latent heat flux. Furthermore, it represents an important water and energy storage component of the regional climate system. Regional simulations of recent and future climate Conditions indicate that a projected increase in summer temperature variability and the occurrence of heat waves in Central and Eastern Europe is mainly interactions (Seneviratne et al., 2006).

### 2.2.6 Seed Size

The small and medium seed fractions were characterized by a tendency to a greater TKW than the large fraction, with the difference amounting to 5.0 and 3.7 g, respectively. In a study by Liu et al. (2012) a thousand seed weight in large-seeded plants of oilseed rape was 13% greater than that in small-seeded crop. The lowest grain moisture at harvest was recorded in plants grown from the small seed fraction (28.9%), while it was the highest in the case of The large fraction (29.2%). In a study by Rukavina et al.(2002) grain moisture content at harvest significantly decreased when large and medium-size seeds were sown in comparison to the small and very small. Ear volume for the small seed fraction was 235.9 cm for the medium fraction it increased by 2.3 cm whereas for the large fraction. It was the lowest and it amounted to 229.4 cm. According to Goggi et al. (2008), seed quality is a very important factor that determines the early development and growth of agricultural crops. Seed size depends on the genotype and environmental conditions in which they developed, and that has an impact on seedling survival,

growth and development.

Farahani et al. (2011) reported obtaining visually more vigorous seedlings from the large seed

fraction of wheat. Also Ries and Everson (1973) in their study on wheat yield showed a relationship of yield and seedling vigour with seed size and its protein content. Ries and Everson (1973) obtained a correlation of 0.69 to 0.87 between seedling vigour and seed size. Also Evans and Bhatt (1977) in their study showed a significant positive correlation between seed size and seedling vigour. According to Chastin et al. (1995), higher seed vigour of larger seeds is connected with larger nutrient reserves in the seeds; hence the larger seeds produce seedlings with greater early growth and an increased competitive ability against weeds and pests.

### 2.2.7 Row Spacing

The depth of seed placement and the distance from the adjacent row both influence crop

performance. The most appropriate row spacing is acompromise between crop yields, ease

of stubble handling, optimizing travel speed, managing weed competition and soil throw and achieving effective use of pre-emergent herbicides.

## 2.3 Effect of Planting Time on Crop Growth

Sadeghi and Niyaki (2013) reported that generally, the time of planting varies depending on the climate condition of the region and the variety to be grown. Zargar et al. (2011) reported that delayed planting dates can accelerate flowering, shorten vegetative and reproductive growth, reduced grain yield and oil content of soybean. Generally, long growing season allows plants to accumulate more dry matter through more vegetative growth. Minor (1976) reported that the date of planting is one of the most critical cultural practices in soybean production. As planting is delayed during the summer season, time to maturity is shortened. Normally the lifecycle duration of late varieties is reduced more than that of early varieties.

### 2.3.1 Effect of planting time on silking, tasseling and physiological maturity

Late planting of maize caused elongation of silking to physiological maturity period due to adverse effect of low temperature on pace of maturity period as well as proper grain black layer filling was also affected (Tollenaar & Bruulsema, 1998). Daynard (1972) observed that time interval requirement of thermal condition during planting to mid – silking stage in maize crop was lengthen whereas requirement of thermal exposure interval by mid – silking to grain black layer formation stage was shorten as a result of late seed sowing. Sutton and Stucker (1974) confirmed that late sowing causes shortening of Growing Degree Days (GDDs) requirement during planting to physiological maturity stage as shifted from early sowing date. Therefore, due to reduced daily incident radiation, cumulative intercepted PAR was reduced during silking to physiological maturity in case of late planting was observed (Tollenaar & Aguilera, 1992). Whereas, late planting of maize caused reduction of Radiation Use Efficiency (RUE) in later growth stage but increased during earlier growth stage. If temperature remains at optimum required level for photosynthesis in maize, low RUE remains constant from emergence to grain filling period (Cirilo & Andrade, 1994). Sangoi (1993) found hybrid maize planted during earlier planting date elongated growth period of more than 2 weeks than planted in delayed date.

### 2.3.2 Effect of planting time on leaf area index

Leaf area index (LAI) is the ratio of total area occupied by a plant leaves per unit total area of land (Watson, 1997). It is an important index to be measured to know rate of plant growth and development status (Steward & Dwyer, 1999). Plant growth activities like photosynthesis, transpiration and accumulation of dry matter mainly depends upon total area occupied by plant canopy and the distribution of leaves which regulate the interception of solar radiation, gaseous exchange and maintain temperature around plant canopy. Therefore, LAI can also be used as important plant growth parameter for doing any researches (Fortin *et al*., 1994). Proper arrangement of leaves and good canopy required for better interception of sunlight promoting photosynthesis and other metabolic processes of crop (Morrison *et al*., 1992). (Monteith, 1981) found that photosynthetically active radiation (PAR) utilized by crop belongs to only half proportion of total incident solar radiation and rest of proportion converts into heat energy.

### 2.3.3 Effect of planting time on kernel number

Bassetti and Westgate (1993) found significant variation in ear growth of maize as the result

of reduction in spikelet initiation stage interval due to extending planting date. Kernel number per cob as well as flower distribution in it also gets adversely affected by delay in planting dates (Otegui & Melon, 1997). Derieux *et al.* (1985) also found kernel number per row and ovule number per row was significantly affected by delay in planting dates.

### 2.3.4 Effect of planting time on grain yield

Early plantation of crop can significantly improves grain yield but besides that other practices like maintaining higher plant population and higher dose of fertilizer also can improve grain yield (Sheperd *et al.*, 1991). Furthermore, early planting helps in early harvesting which helps to avoid possible unfavorable environmental conditions as well as save more labour and time also (Hicks *et al*., 1972).

## 3. Conclusion

Water use efficiency (WUE) is a concept introduced 100 years ago by Briggs and Shantz (1913) showing a relationship between plant productivity and water use. They introduced the term, WUE, as a measure of the amount of biomass produced per unit of water used by a plant. Vast amounts of water are transpired in comparison with the small amounts of carbon that are fixed by photosynthesis. Seeds can get water, oxygen, and sun by being placed at the proper planting depth. Planting depth is the depth at which a seed is placed in the soil. The germination process begins when water and oxygen are pulled into the seed by the seed's coating. The embryo's cells grow bigger as water and air. After this step, a root sprouts from the seed germination can be caused by improper planting depth, over watering, or dry conditions.

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