# Effect of Planting Months, Spacing and Mulching on Soil Temperature and Emergence of Cucumber (*Cucumis sativus* L)

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***ABSTRACT***

*Low soil temperatures that occur during the period of high rainfall is a limiting factor to seedling emergence of cucumber and there is a gap in knowledge on how these low soil temperatures can be increased using different cultural practices. A field experiment was therefore conducted in 2015 cropping season to evaluate effect of planting months, spacing and mulching on soil temperature and emergence of cucumber (Cucumis sativus L). Treatments consisted of three factors; [main plot was months of planting (April, May, June, July, August and September), sub plot was spacing (20cm x 50cm, 40cm x 50cm and 60cm x 50cm) and sub-sub plot was mulching (no mulch, black polythene, transparent polythene and wood shaving)] and were all replicated three times. Results recorded little interaction effect on soil temperature and 50% emergence. April and May had the highest soil temperatures and also recorded the lowest number of days to 50% emergence. Black polythene recorded the highest soil temperatures in April, May, September and July, followed by transparent polythene with the highest soil temperatures only in April and May. Black polythene recorded the lowest number of days to 50% emergence in May and September and also the lowest number of days to 50% emergence. April and May planting had the lowest number of days to 50% emergence and higher soil temperature. Black polythene performed better than other mulch types, it increased soil temperatures and also improved cucumber seedling emergence.*

***KEY WORDS:*** *planting month; spacing; mulching; temperature; cucumber.*

## INTRODUCTION

Cucumber is a widely grown annual vegetable crop in the cucurbitaceae family. It is well adapted to temperate and tropical zones and because of their wide adaptation from arid to the humid environment (Bates *et. al*.,1990), it can be grown at any time of the year but Nu (1998) reported that cucumber is warm season crop and has little or no tolerance to frost. Cobeil and Gosselin, (1990) reported that it requires a warm and stable temperature for good yield. Anon, (2014) reported that the higher the soil temperature, the more rapidly cucumber seedlings emerge and also reported that at 21°C, only 5 to 6 days are required for seedlings to emerge. Elaine, (2015) reported that the optimum soil temperature range at planting is 25°- 30°C (77°-86° F.)

Studies have shown that mulches maintain soil temperatures because they act as insulators and keep the soil warm during cool weather and cooler during warm weather. Anderson *et.al*.,(1995) stated that different mulches may improve soil temperatures as they absorb solar radiation and

there by heat up the soil. According to Verdu and Mas (2007), different types of mulches include; living mulches, polyethylene and non-living organic mulches such as straw, saw dust, wood shaving, bark of trees and plant residues. Jill (2011), reported that cucumber is a warm season crop therefore, using black plastic mulch will help to increase soil temperature. Coolong (2010) also reported that black polythene mulch resulted in highest soil temperatures compared to other mulch types. Planting cucumber in periods when the soil temperature is high, improves seedling emergence.

In south eastern Nigeria where there is high rainfall and extreme soil temperature, cucumber production is mainly done by peasant farmers who are not equipped with the right information on cultural practices that could be carried out to ensure moderate soil temperature for improved emergence, since delayed germination and seedling emergence cause non uniform stand establishment and seedlings are subjected to soil-borne pathogens (Anon, 2017). These peasant farmers grow cucumber in mixture with other crops and not as the main crop hence, they do not maintain the correct spacing that is required for optimum growth and yield. Nweke *et. al*., (2013) reported that close spacing had effect on vegetative growth of cucumber. Close spacing could help keep the soil warm since cucumbers are also used as living mulch.

In order to ascertain the best period of the year that cucumbers could be planted for maximum seedling emergence and the best spacing and mulch material required to provide the soil temperature that is required for seedling emergence; this study was therefore carried out to determine the effect of planting months, spacing and mulching on soil temperature and emergence of cucumber (*Cucumis sativus* L) to determine their interaction effect and main effect on soil temperature and seedling emergence.

## MATERIALS AND METHODS

The experiment was conducted in April, May, June, July, August and September in 2015 cropping season at the Teaching and Research Farm, School of Agriculture and Agricultural Technology, Federal University of Technology Owerri, Imo state. Owerri is in the humid forest zone of Southeastern Nigeria and is characterized by annual rainfall of about 2000mm, minimum and maximum temperatures of between 20°C and 32°C respectively (Ononiwu, 1990). In 2015, the minimum and maximum temperatures were 28.32°C and 32°C, annual rainfall was 2206mm. Temperature and rainfall data for 2015 are presented in table 1.

The land was cleared manually and tilled to make seed beds. Each bed was 3.6 meters long and 1 meter wide, the experiment was carried out using a split-split plot arrangement fitted into a Randomized Complete Block Design. The treatments consisted of three factors (planting months, spacing and mulching). The main plot was planting months (April, May, June, July, August and September), the sub plot was spacing (20cm x 50cm, 40cm x 50cm and 60cm x 50cm) and sub-sub plot was mulching (no mulch, black polythene, transparent polythene and wood shaving) all were replicated three times.

Seeds of proven variety of cucumber (cu999) were sown on the plots at the rate of 2 seeds / stand according to treatment, at a depth of 2 cm, seedlings were later thinned to 1 seedling/stand. Planting was done in the months of April, May, June, July, August and September in 2015.

The parameters that were measured include days to 50% emergence: this was obtained by counting the number of days it took for 50% of the plant population to emerge.
Soil temperatures were also measured after mulching, in the morning and afternoon hours using soil thermometers.
All data collected were subjected to analysis of variance while means were separated using Genstat Discovery Edition 3 (Genstat, 2007) software.

**Results**

**Table 1: Average Monthly Temperature ($^0$C) and Rainfall (mm) for 2015 in Imo State**

| Month | Monthly Temperature ($^0$C) | | Monthly Rainfall (mm) |
|---|---|---|---|
| | Maximum | Minimum | |
| January | 33.55 | 19.77 | 12.4 |
| February | 34.21 | 23.85 | 71.7 |
| March | 33.50 | 23.15 | 61.0 |
| April | 33.65 | 23.56 | 61.4 |
| May | 32.60 | 23.06 | 236.6 |
| June | 29.86 | 22.38 | 360.1 |
| July | 29.30 | 23.07 | 325.8 |
| August | 28.98 | 22.49 | 354.2 |
| September | 30.34 | 22.57 | 351.9 |
| October | 31.21 | 22.66 | 324.3 |
| November | 33.10 | 22.90 | 46.7 |
| December | 33.65 | 18.33 | 0.0 |

Source: NIMET (2015)

**Table 2: Effect of Different Cultural Practices on Soil Temperature ($^0$C) after mulching**

| | | Months | | | | | |
|---|---|---|---|---|---|---|---|
| Mulching | Spacing | April | May | June | July | August | Sept |
| NM | Morning | 28.50 | 28.33 | 27.33 | 28.30 | 28.00 | 29.10 |
| | Afternoom | 36.83 | 33.67 | 30.67 | 33.33 | 30.33 | 32.50 |
| BP | Morning | 29.17 | 29.00 | 23.83 | 29.17 | 29.17 | 29.67 |
| | Afternoom | 37.33 | 35.00 | 32.17 | 33.67 | 33.17 | 34.00 |
| TP | Morning | 28.67 | 28.17 | 28.00 | 28.33 | 26.67 | 29.00 |
| | Afternoom | 38.17 | 35.33 | 33.67 | 32.50 | 32.00 | 34.17 |
| WS | Morning | 28.50 | 28.17 | 27.50 | 28.00 | 28.50 | 38.50 |
| | Afternoom | 32.83 | 31.83 | 30.83 | 30.33 | 31.17 | 32.33 |
| | LSD $_{0.05}$ (Month x Spacing x Mulching) = NS | | | | | | |
| Spacing | Morning | 28.71 | 28.42 | 27.92 | 28.45 | 28.58 | 29.07 |
| | Afternoom | 36.29 | 33.96 | 31.83 | 32.46 | 31.67 | 33.25 |
| | LSD $_{0.05}$ (Month x Spacing) = 1.36 | | | | | | |
| Mulching | NM | 32.67 | 31.00 | 29.00 | 30.82 | 29.17 | 30.80 |
| | BP | 33.25 | 32.00 | 30.50 | 31.42 | 31.17 | 31.83 |
| | TP | 33.42 | 31.75 | 30.83 | 30.42 | 30.33 | 31.58 |
| | WS | 30.67 | 30.00 | 29.17 | 29.17 | 29.83 | 30.42 |
| | LSD $_{0.05}$ (Month x Mulching) = NS | | | | | | |

| Spacing | Mulching | | | |
|---|---|---|---|---|
| | NM | BP | TP | WS |
| Morning | 28.26 | 29.17 | 28.47 | 28.20 |
| Afternoom | 32.89 | 34.22 | 34.31 | 31.55 |

LSD $_{0.05}$ (Spacing x Mulching) = 1.06

| Month | April | May | June | July | August | Sept |
|---|---|---|---|---|---|---|
| | 32.50 | 31.19 | 29.88 | 30.46 | 30.12 | 31.16 |

LSD $_{0.05}$ (Month) = 0.77

| Spacing | Morning | Afternoon |
|---|---|---|
| | 28.53 | 33.24 |

LSD $_{0.05}$ (Spacing) = 0.70

| Mulching | NM | BP | TP | WS |
|---|---|---|---|---|
| | 30.58 | 31.70 | 31.90 | 29.88 |

LSD $_{0.05}$ (Mulching) = 0.69

NM = No mulch
BP = Black polythene
TP = Transparent polythene
WS= Wood shaving

**Table 3:Effect of Treatments on Days to 50% Emergence**

| Mulching | Spacing | April | Months May | June | July | August | Sept |
|---|---|---|---|---|---|---|---|
| NM | 20x50 | 5.00 | 5.00 | 6.00 | 6.33 | 6.33 | 5.00 |
| | 40x50 | 5.67 | 5.33 | 6.67 | 5.67 | 6.33 | 5.00 |
| | 60x50 | 5.00 | 5.00 | 6.33 | 6.00 | 6.33 | 5.00 |
| BP | 20x50 | 5.00 | 5.00 | 6.00 | 5.67 | 5.00 | 5.00 |
| | 40x50 | 5.33 | 5.00 | 5.67 | 5.67 | 5.00 | 5.00 |
| | 60x50 | 5.00 | 5.00 | 6.33 | 5.67 | 5.33 | 5.00 |
| TP | 20x50 | 5.00 | 5.00 | 5.67 | 5.33 | 5.00 | 5.33 |
| | 40x50 | 5.00 | 5.33 | 6.33 | 5.33 | 5.00 | 5.67 |
| | 60x50 | 5.33 | 5.00 | 6.33 | 5.67 | 5.12 | 5.00 |
| WS | 20x50 | 5.00 | 5.00 | 7.00 | 5.00 | 6.33 | 6.00 |
| | 40x50 | 5.33 | 5.00 | 6.67 | 5.33 | 5.67 | 6.33 |
| | 60x50 | 5.00 | 5.33 | 7.00 | 5.33 | 6.67 | 5.00 |
| | LSD $_{0.05}$ (Month x Spacing x Mulching) = NS | | | | | | |
| Spacing | 20x50 | 5.00 | 5.00 | 6.17 | 5.58 | 5.67 | 5.33 |
| | 40x50 | 5.33 | 5.17 | 6.33 | 5.50 | 5.50 | 5.25 |
| | 60x50 | 5.08 | 5.17 | 6.42 | 5.67 | 5.86 | 5.00 |
| | LSD $_{0.05}$ (Month x Spacing) = 0.50 | | | | | | |
| Mulching | NM | 5.22 | 5.22 | 6.33 | 6.00 | 6.33 | 5.00 |
| | BP | 5.11 | 5.00 | 5.89 | 5.67 | 5.11 | 5.00 |
| | TP | 5.11 | 5.11 | 6.11 | 5.44 | 5.04 | 5.33 |
| | WS | 5.11 | 5.11 | 6.89 | 5.22 | 6.22 | 5.44 |

LSD $_{0.05}$ (Month x Mulching) = 0.46

| Spacing | Mulching | | | |
|---|---|---|---|---|
| | NM | BP | TP | WS |
| 20x50 | 5.61 | 5.28 | 5.22 | 5.72 |
| 40x50 | 5.78 | 5.28 | 5.44 | 5.56 |
| 60x50 | 5.67 | 5.33 | 5.40 | 5.72 |

LSD $_{0.05}$ (Spacing x Mulching) = NS

| Month | April | May | June | July | August | Sept |
|---|---|---|---|---|---|---|
| | 5.14 | 5.11 | 6.31 | 5.58 | 5.68 | 5.19 |

LSD $_{0.05}$ (Month) = 0.23

| Spacing | 20x50 | 40x50 | 60x50 |
|---|---|---|---|
| | 5.46 | 5.51 | 5.53 |

LSD $_{0.05}$ (Spacing) = NS

| Mulching | NM | BP | TP | WS |
|---|---|---|---|---|
| | 5.68 | 5.29 | 5.36 | 5.67 |

LSD $_{0.05}$ (Mulching) = 0.19

NM = No mulch
BP = Black polythene
TP = Transparent polythene
WS= Wood shaving

**Discussion**

The interaction had no significant effect on soil temperature and days to 50% emergence except month x spacing interaction. In the morning periods, September planting recorded the highest soil temperature (29.07°C), followed by April planting (28.71°C) while in the afternoon period, April and May recorded higher soil temperature (36.29°C) and (33.96°C) and also recorded lowest days (5.00) to 50% emergence. June planting recorded the least soil temperature (29.88°C) and also recorded the highest days (6.31) to 50% emergence. These findings agree with Anon (2014) who stated that the higher the soil temperature, the more rapidly cucumber seedlings emerge. On the main or individual effect; April and May recorded higher soil temperatures of 32.50°C and 31.19°C respectively because of the low rainfall (61.40mm) that occurred in April and May (236.60mm) and high atmospheric temperatures of 33.65°C and 32.60°C respectively as seen in table 1. April and May recorded lower days (5.14 and 5.11) to 50% emergence due to high soil temperatures recorded in both months.

Spacing effect had significant effect at P>0.05 on soil temperature but had no significant effect on days to 50% emergence. Temperatures taken in the morning periods wer consistently lower than

those taken in the afternoon periods because of the coolness of the night and morning and their low atmospheric temperature. Effect of mulching was significant soil temperature and on days to 50% emergence. Plots without mulch had the highest number of days (5.68) to 50% emergence while plots treated with black polythene recorded the lowest (5.29) number of days. The reason for the highest number of days to 50% emergence on plots without mulch and lowest number of days to 50% emergence on plots treated with black polythene could be attributed to the fact that plots without mulch recorded low soil temperature (30.58°C) since the soil was not covered with mulch materials while plots treated with black polythene recorded higher soil temperature (31.70°C). This could be attributed to the fact that black polythene intercepts and absorbs all in coming radiation but transmits only little as reported by Hudu *et. al*., ( 2002). These findings also agree with Coolong (2010) who reported that using black polythene mulch resulted in highest soil temperatures compared to other mulch types. Jill (2011) also reported that cucumber is a warm season crop therefore; using black plastic mulch will help to increase soil temperature.

## Conclusion

April and May had the highest soil temperatures and the least number of days to 50% seedling emergence hence, it could be concluded that April and May are the best planting months for cucumber. Also, black polythene was able to raise soil temperature better than other mulch types and also recorded the lowest days to 50% emergence. Black polythene is therefore recommended for higher soil temperature and early seedling emergence. The interaction of month x spacing recorded higher soil temperature than the individual effect and also recorded lower days to 50% emergence.

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