551.573 : 633.17

RESPONSE OF BIOMASS PRODUCTION TO WEATHER PARAMETERS IN SORGHUM

1. There has been a continuous interest in grain sorghum (*Sorghum bicolor* L. Meench) throughout the world. In northern India, sorghum has been widely adopted by the farmers as a fodder crop. However, the seed setting in this crop is very shy being the forage cultivars. The time of sowing is the most important factor which decides the available period for vegetative and reproductive phases and ultimately the yield.

The biomass production depends upon agricultural practices and meteorological parameters during the growing season. Various relationships have attempted for expressing biomass production in terms of the parameters, like growing degree days (GDD) and pan evaporation (EP).

2. *Materials and method*—Field experiments were conducted at research farm of Department of Agricultural Meteorology, Haryana Agricultural University, Hisar (Lat. 29°10′ N, Long. 75°46′E, height 215.2 m) during kharif seasons of 1986 and 1987. The experiment comprised of three dates of sowing (5, 20 June—D_1, D_2 and 5 July –D_3) and two cultivars (HC-260, CV_1, and HC-171, CV_2). All the treatments were replicated thrice in a randomised block design. The crop was raised as per the recommended package of practices. The soil of the experimental field was sandy loam. The biomass observations were taken first as soon as the plants were established (which is affected generally about twenty days after the date of sowing) and then subsequently at every 15 days intervals up to the maturity stage of the crop. Thus six biomass observations were taken for each year. The biomass samples were taken randomly from each field. Then dry weight was determined after oven drying. Maximum and minimum temperatures (in degree celsius) and open pan evaporation (in mm) by U.S.A. class A-type open pan evaporimeter were recorded at observatory located about 100 m away from the field. Taking a base temperature as 10°C for sorghum, a growing degree day (GDD) was calculated by $(T_{max} + T_{min}/2) - 10$. The number of degree days was then computed from the date of sowing to each day of observation for each experiments. Similarly accumulated evaporation was computed corresponding to each biomass observation from the date of sowing for each sowing date and variety for both years. Then the data of both years were pooled to develop the response functions between the accumulated dry biomass with growing degree days and pan evaporation of the form of :

$$y = a + bx \qquad -1$$

$$y = a + b \log x \qquad -2$$

TABLE 1

Regression equations relating dry biomass of sorghum with weather parameters

Parameters	Sowing dates and varieties	Equation of y $y=e^{a+b \log x}$	R^2	F-value
GDD	D_1	exp −15.25+2.60 log x	0.87	62.84
GDD	D_2	exp −11.91+2.16 log x	0.88	72.53
GDD	D_3	exp −7.646+1.60 log x	0.84	50.57
GDD	CV_1	exp− 11.68+2.14 log x	0.86	59.38
GDD	CV_2	exp−11.54+2.11 log x	0.85	57.95
EP	D_1	exp− 17.81+3.21 log x	0.87	67.68
EP	D_2	exp− 14.48+2.76 log x	0.91	100.19
EP	D_3	exp −1.67+0.913 log x	0.67	19.94
EP	CV_1	exp −14.91+2.83 log x	0.94	145.79
EP	CV_2	exp −14.67+2.78 log x	0.94	147.10

N=12, EP — Evaporation mm/ day,
GDD — Growing degree days.

$$y = e^{a + bx} \quad -3$$

$$y = e^{a + b \log x} \quad -4$$

$$y = a + bx_1 + cx_2 \quad -5$$

where,

y — Accumulated dry biomass production (dependent variable) in gm/plant,

x, x_1, x_2 — Growing degree days (day °C) and pan evaporation (independent variables in mm/day),

a — Regression constant,

b, c — Regression coefficients for independent variables, and

e — Exponential function.

3. *Results and discussion*—Various relationships were studied between accumulated biomass production and GDD and evaporation (EP).

Simple linear regression relationship (No. 1) between biomass production and the growing degree day and biomass production and cumulative pan evaporation explained the dry biomass production (DBP) variations up to 81 to 90 per cent and 76 to 92 per cent respectively. These are highly significant as F-values ranged from 37.92 to 205.01 against tabulated value of 10.04 at $P<0.01$. Similar simple linear relationships were studied by Chakravarty and Sastry (1983) in case of moong and wheat crop.

The exponential response function (No. 3) between dry biomass production and growing degree day, and dry biomass production and pan evaporation were also found significant, explaining dry matter variations from 75 to 80 and 63 to 90 per cent respectively. Ganesan *et al.* (1988) also reported similar relationships in rabi crops.

Similarly the response function of the form $y = e^{a+b \log x}$ (y — dry biomass production, x — GDD or EP) were also developed, which explained the dry matter variations up to 84 to 88 per cent with use of GDD and 67 to 94 per cent with use of EP (Table 1) with F-values ranging from 19.94 to 147.10 which were higher than the tabulated value of 10.04 at $P<0.01$. Here the dry matter variation in third date of sowing D_3 was less explained with EP parameter.

TABLE 2

Multiple regression relating dry biomass of sorghum with weather parameters

Sowing dates and varieties	Equation of y $y=a+b\,x_1+c\,x_2$	R^2	F-values
D_1	−95.599+0.0255 GDD+0.14 EP	0.94	67.06
D_2	−74.954+0.0263 GDD+0.122 EP	0.95	94.76
D_3	−35.310+0.104 GDD+0.10 EP	0.99	112.59
CV_1	−81.619+0.021 GDD+0.143 EP	0.98	169.21
CV_2	−74.792+0.010 GDD+0.13 EP	0.97	164.06

It was also observed that dry matter production was highly related separately with cumulative GDD and evaporation in logarithmic expression (No. 4) explaining 85 to 91 per cent variations with GDD and 65 to 92 per cent variations with pan evaporation. However, in case of third date of sowing it was much less for cumulative pan evaporation parameter indicating lower response of dry matter production with evaporation rate under late sown condition.

Dry biomass production was a linear multiple function of cumulative growing degree days and pan evaporation (Table 2), explaining 94 to 99 per cent variations with F-values of 67.06 to 169.21 which are much higher than the tabulated values of 8.07.

4. *Conclusions* — (*i*) The multiple regression analysis of the form $y = a + b\,x_1 + c\,x_2$ (y — biomass production in gm/plant; x_1 and x_2 —GDD and EP) was most satisfactory explaining 94 to 99 per cent variations in dry matter production.

(*ii*) The relationship of the form $y = e^{a + b \log x}$ was overall best among the other single parameter relationships except with EP parameter in 5th July sowing date.

References

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