AJES
ASIAN JOURNAL OF ENVIRONMENTAL SCIENCE
■ VOLUME 10 | ISSUE 1 | JUNE, 2015 | 20-28 ■ e ISSN-0976-8947
DOI: 10.15740/HAS/AJES/10.1/20-28
■ Visit us : *www.researchjournal.co.in*

RESEARCH ARTICLE

Impact of weather parameters in linseed (*Linum usitatissimum* L.) on various genotypes and sowing times

■ B.S. ROKADE, K.T. MADANE, J.D. JADHAV AND P.S. KAMBLE

Article Chronicle :
Received **:**
29.01.2015;
Revised **:**
22.03.2015;
Accepted **:**
13.04.2015

ABSTRACT : Split Plot Design with three replications was laid out in field experiment. The treatments consist of 6 dates of sowing D_1: 40th MW, D_2: 41st MW, D_3: 42nd MW, D_4: 43rd MW D_5: 44th MW and D_6: 45th MW as main plot treatment and 3 cultivars V_1: Kiran V_2: Garima V_3: RLC-4 as sub plot treatment at College of Agriculture latur during *Rabi* season. First date (D_1) and second date (D_2) crop sown in MW 40 and MW 41 recorded significantly higher leaf area index than other dates of sowing. Correlation study between seed yields and weather parameters of Garima cultivar reported significant positive correlation between T_{max}, T_{mean}, RHI, RHII, and RH_{mean} in P_2 stage (Emergence to branching) while at critical growth stages weather had no significant effect. In respect of cultivar kiran different trend was observed in P_4 stage (Flowering to capsule formation). Only T_{min} and GDD have reported positive correlation. When correlation study between straw yields and weather parameters of above cultivars was to known, Garima cultivar reported significant positive association with T_{min}, T_{mean}, RHI, RHII and RH_{mean} during P_3 stage (Branching to flowering). Cultivar Kiran have also reported significant positive correlation during P_3 stage (Branching to flowering). The significant negative correlation in respect of air temperature indicated that higher minimum temperatures are not ideal for optimum seed yield. The positive significant correlation of humidity values are explainable that higher air temperature indirectly decreased the humidity and there by seed yield.

Key Words :
Weather parameters, Linseed, Genotypes, Sowing time

HOW TO CITE THIS ARTICLE : Rokade, B.S., Madane, K.T., Jadhav, J.D. and Kamble, P.S. (2015). Impact of weather parameters in linseed (*Linum usitatissimum* L.) on various genotypes and sowing times. *Asian J. Environ. Sci.*, **10**(1): 20-28.

Author for correspondence :
J.D. JADHAV
Zonal Agricultural Research Station,
SOLAPUR (M.S.) INDIA
Email: slp.aicrpam@gmail.com
See end of the article for **Coopted authors'**

The area under cultivation of linseed (*Linum usitatissimum* L.) is increasing recently but work on the agro meteorological aspect is limited. Consequently, it is difficult to recommend weather based better agronomic practices for higher yield. The seed yield is influenced considerably by different date of sowing suggested by various workers. Delayed sowing after 15th October reduced the seed as well as straw yield (Verma and Pathak, 1993). The meteorological parameters play an important role in deciding the fate of the crop, because these strongly influence the physiological expression of genetic potential of the crop. It is well known that yield from any given crop or cultivar depends on the availability of certain optimum condition of solar radiation, temperature, heat units etc. during different growth stages of the crop (Doorenbos and Pruitt, 1977).

With these objectives in mind, the study was planned with following objectives :

– To identify the suitable sowing time in linseed crop based on weather conditions prevailed under Latur condition.

– To estimate the impact of individual weather element prevailed during different phenological growth stages in relation to the crop performance (yield).

Experimental Methodology

Experiment was laid out in Split Plot Design with three replications. The treatments consist of 6 dates of sowing D_1: 40th MW, D_2: 41st MW, D_3: 42nd MW, D_4: 43rd MW D_5: 44th MW and D_6: 45th MW as main plot treatment and 3 cultivars V_1: Kiran V_2: Garima V_3: RLC-4 as sub plot treatment at College of Agriculture Latur during *Rabi* season. The data recorded were statistically analyzed by using technique of analysis of variance (Fisher, 1970) and significance was determined as given by Panse and Sukhatme (1967). To have better in sight of the impact the of different weather variables on crop growth and yield, correlation study between seed yield, straw yield and total biomass was done and the correlation co-efficient of the weather variables, prevailed in different phenophages, were assessed and tabulated.

Experimental Findings and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Dry matter accumulation :

The data presented in Table 1 indicated that the dry matter accumulation plant^{-1} was increased continuously from emergence to harvest of crop. The rate of increasing dry matter accumulation was slow up to 60 DAS and it was remarkably fast between 60-75 DAS.

Date of sowing :

The data presented in Table 1 revealed that the mean total dry matter (g plant^{-1}) was influenced significantly due to different time of sowing as the crop growth advanced. The data presented in Table 1 revealed than mean dry matter plant^{-1} was significantly higher at first date (MW 40) than other treatments of sowing time. Similar results were also reported by Samui and Bandopadhyay (1991).

Cultivars :

The effect of cultivars on dry matter plant^{-1} is presented in Table 1. The data reported that total dry matter accumulation plant^{-1} was significantly higher in cv. GARIMA over other cultivar but it was at par with Kiran, through out the crop period.

Yield :

The data regarding yield *viz.*, seed yield, straw yield, and total biomass are presented in Table 2.

Seed yield (kg ha^{-1}) :

The data presented in Table 2 revealed that mean seed yield (kg ha^{-1}) was influenced significantly by various dates of sowing and cultivars.

Table 1 : Mean periodical dry matter accumulation plant^{-1} (g) as influenced by various treatments

Treatment details	Days after sowing						
	30	45	60	75	90	105	HAR
Date of sowing							
D_1 (MW 40)	0.48	1.2	2.3	5.1	5.3	2.4	2.3
D_2 (MW 41)	0.26	0.9	1.4	4.3	4.3	2.1	2.0
D_3 (MW 42)	0.25	1.2	1.4	2.4	2.7	2.2	2.1
D_4 (MW 43)	0.41	0.7	1.2	2.7	2.5	1.8	1.7
D_5 (MW 44)	0.35	0.7	2.0	2.6	2.7	1.4	1.3
D_6 (MW 45)	0.05	0.5	0.9	1.2	1.5	1.0	1.0
S.E. ±	0.06	0.02	0.02	0.21	0.18	0.03	0.05
C.D. (P=0.05)	0.021	0.08	0.08	0.38	0.32	0.09	0.8
Cultivars							
V_1 -Kiran	0.19	0.18	1.5	2.6	2.8	1.8	1.7
V_2- Garima	0.21	0.9	1.7	3.2	3.5	1.9	2.0
V_3- RLC-4	0.20	0.9	1.6	2.6	2.9	1.8	1.8
S.E. ±	0.005	0.02	0.04	0.06	0.02	0.26	0.043
C.D. (P=0.05)	0.015	0.06	0.08	0.19	0.06	0.08	0.12

Date of sowing :

The mean seed yield (kg $^{-1}$ha) was found significantly higher in first (D_1) at MW 40 over other date of sowing treatments and was significantly superior. Similar trends were also recorded by Verma and Pathak (1993) and Sharma *et al*. (1995).

Cultivars :

The effect of cultivars on seed yield ha^{-1} revealed that cv. GARIMA produced significantly higher seed yield than other cultivars. Similar findings were also reporded by Verma and Pathak (1993).

Straw yield :

Data presented in Table 2 revealed that the mean straw yield of linseed was in influenced significantly by different treatment.

Date of sowing :

The data presented in Table 2 revealed that first (D_1) date of sowing at MW 40 gave highest yield of 2999 kg ha^{-1} and was significantly superior than other date of sowing treatments. The second and third highest position in respect of grain yield of linseed was acquired by D_2 and D_3 treatment at MW 41 and MW 42. Above results were in confirmation with Dixit *et al*. (1994). The significantly lowest grain yield of linseed was acquired by D_6 treatment at MW 45.

Cultivars :

The effect of cultivars on straw yield ha^{-1} presented in Table 2 revealed that cv. GARIMA gave significantly higher straw yield than other cultivars.

Biological yield (kg ha^{-1}):

The data presented in Table 2 revealed that mean biological yield was influenced significantly by different treatments.

Date of sowing:

The data presented in Table 2 revealed that biological yield was found significantly more in first (D_1) date of sowing at MW 40 than other dates of sowing. The similar findings have been reported by researchers Dixit *et al.* (1994).

Cultivars :

The effect of cultivars on biological yield ha^{-1} revealed that cv. GARIMA was significantly superior than other cultivars.

Correlation studies :

The weather element play important role in success or failure of the crop. The weather requirement varies differently in the different phenophase and hence, the study of individual weather element prevailed during different phenopheses was conducted by studying the

Table 2 : Mean seed yield (kg ha^{-1}), straw yield (kg ha^{-1}), total biomass (kg ha^{-1}), as influenced by various treatments

Treatments	Seed yield (kg/ha)	Straw yield (kg/ha)	Total biomass (kg/ha)
Date of sowing			
D_1 (MW 40)	889	2109	2998
D_2 (MW 41)	823	2999	2822
D_3 (MW 42)	654	1999	2653
D_4 (MW 43)	543	1540	2083
D_5 (MW 44)	473	1582	2055
D_6 (MW 45)	334	979	1313
S.E. ±	7.33	10.48	12.43
C.D. (P=0.05)	23.12	33.05	39.19
Cultivars			
V_1 –Kiran	613	1619	2232
V_2- Garima	656	1773	2429
V_3- RLC-4	588	1712	2300
S.E. ±	6.4	6.8	6.5
C.D. (P=0.05)	19.0	19.92	19.02

degree of association between seed yield and total biomass versus weather element. The weather elements considered are maximum temperature (T_{max}), minimum temperature. (T_{min}), mean temperature (T_{mean}), temperature range (T_{range}), morning time relative humidity (RHI), noon time relative humidity (RHII), average humidity (RH_{mean}) and humidity range (RH_{range}) as well as an agro meteorological index (Growing Degree Days) GDD were included in this study. The correlation co-efficients for each cultivar were estimated through multiple correlation techniques and are presented in Table 3, 4 and 5 for seed yield and 6, 7 and 8 for total biomass.

Seed yield (Kiran) :

The data presented in Table 3 reported non-significant association during P_1 (Sowing to emergence) during P_2 (emergence to branching) the T_{max}, T_{min}, RHII, RH_{mean} and GDD reported significantly association with seed yield whereas, T_{range}, reported significant negative association with seed yield. During P_3 stage of growth (branching to flowering) T_{min}, RHI, RHII, RH_{mean} and GDD reported significant positive association. The degree of association with seed yield and weather parameters studied during P_4 (Flowering to capsule formation) a different trend was obtained where in, only T_{min} and GDD reported significant positive correlation while RHI, RHII, RH_{mean}, and RH_{range} exhibited significant negative association indicating that increase in relative humidity during this critical growth stage is quite unfavourable for seed setting.

V_2 (Garima) :

The data presented in Table 4 reported seed yield of this cultivar ranked first. Correlations studies indicate that during P_2 stage (emergence to branching) T_{max}, T_{mean}, RHI, RHII, and RH_{mean} reported significantly positive correlation, whereas, during P_3 stage (branching to flowering) T_{min}, T_{mean}, RHI, RHII, RH_{mean} and GDD

Table 3 : Correlation co-efficient between seed yield and different weather variables prevailed in various phenophases of linseed cultivar Kiran

Weather variable	Phenophases					
	P_I	P_{II}	P_{III}	P_{IV}	P_V	P_{VI}
T_{max}	0.01094	0.88149**	0.52396	0.19354	0.87189**	-0.96175**
T_{min}	0.05356	0.90094**	0.79783*	0.75236*	0.67367	-0.85647**
T_{mean}	0.02790	0.90096**	0.67868	0.5594	0.43130	-0.90974**
T_{range}	-0.02411	-0.82934**	0.23195	-0.21515	-0.77141*	0.68752
RH-I	-0.34386	0.73198	0.98090**	-0.90756**	-0.15345	0.37745
RH-II	-0.42931	0.84372**	0.98190**	-0.95700**	-0.82681**	0.75945*
RH_{mean}	-0.38806	0.79980*	0.98100**	-0.94019**	-0.57826	0.63833
RH_{range}	-0.68116	0.88935**	-0.47353	-0.85631**	-0.50334	0.63833
GDD	-0.61313	0.89396**	0.76314*	0.92139**	0.57877	-0.52228

* and ** indicate significance of value at P=005 and P=0.01, respectively; P_1 = Sowing to emergence, P_3 = Branching to flowering P_5 = Capsule formation to capsule development P_2 = Emergence to branching P_4 = flowering to capsule formation P_6 = Capsule development to maturity

Table 4 : Correlation co-efficient between seed yield and different weather prevailed in various phenophases of linseed cultivar Garima

Weather variable	Phenophases					
	P_I	P_{II}	P_{III}	P_{IV}	P_V	P_{VI}
T_{max}	0.46310	0.87467**	0.59176	-0.48251	0.91527**	0.62650
T_{min}	0.00603	0.65024	0.76149*	0.57173	0.97829**	0.56788
T_{mean}	0.19572	0.85704**	0.88131**	-0.18367	0.96900**	-0.49395
T_{range}	0.21973	0.11691	-0.41357	-0.53613	-0.71392	-0.75157
RH-I	-0.56897	089047**	0.90664**	-0.69488	0.50685	0.68889
RH-II	-0.55655	0.88746**	0.88642**	-0.40463	-0.84327**	0.69879
RH_{mean}	-0.57567	0.90561**	0.90608**	-0.55704	-0.70270	0.71370
RH_{range}	-0.18932	0.17796	-0.43363	0.40129	0.48399	0.39321
GDD	0.05234	0.71006	0.77388*	0.4139	0.92631**	-0.71810

* and ** indicate significance of value at P=005 and P=0.01, respectively; P_1 = Sowing to emergence P_3 = Branching to flowering P_5 = Capsule formation to Capsule development P_2 = Emergence to branching P_4 = flowering to capsule formation P_6 = Capsule development to maturity

Table 5 : Correlation co-efficient between seed yield and different weather variables prevailed in various phenophases of linseed cultivar RLC-4

Weather variable	Phenophases					
	P_I	P_{II}	P_{III}	P_{IV}	P_V	P_{VI}
T_{max}	0.26102	0.16881	0.93779**	0.24239	-0.30966	0.23281
T_{min}	-0.39089	0.54886	0.84535**	0.94506**	0.55896	0.76889**
T_{mean}	-0.28618	0.36848	0.94226**	0.91241**	0.49040	0.52069
T_{range}	0.42231	-0.37645	0.34234	-0.55256	-0.66181	-0.39111
RH-I	-0.67992	0.81552**	83419**	0.13259	-0.4891	0.23509
RH-II	-0.7605*	0.80134*	0.82030**	0.43153	-0.62018	0.19962
RH_{mean}	-0.72251	0.81074*	0.82766**	0.29837	-0.45801	0.21515
RH_{range}	-0.8397**	0.21384	-0.42441	0.66626	-0.20323	-0.33855
GDD	-0.8320**	0.96140**	0.80725*	0.21413	0.93635**	0.40071

* and ** indicate significance of value at P=005 and P=0.01, respectively; P_1 = Sowing to emergence P_3 = Branching to flowering P_5 = Capsule formation to Capsule development; P_2 = Emergence to branching P_4 = flowering to capsule formation P_6 = Capsule development to maturity

Table 6 : Correlation co-efficient between total biomass yield and different weather variables prevailed in various phenophase of linseed cultivar Kiran

Weather variable	Phenophases					
	P_I	P_{II}	P_{III}	P_{IV}	P_V	P_{VI}
T_{max}	0.05301	0.94047**	0.41243	0.00479	-0.79215*	-0.90882**
T_{min}	0.21306	0.91528**	0.82075**	0.44189	0.63133	-0.84189**
T_{mean}	0.12731	0.93801**	0.59080	0.23677	0.43044	-0.90953**
T_{range}	-0.0089	-0.79895*	0.098400	-0.18023	-0.71980	0.69623
RH-I	-0.17838	0.60766	0.88840**	-0.85466**	0.01295	-0.0335
RH-II	-0.26617	0.75165*	0.89182**	-0.77532	-0.60291	0.79768*
RH_{mean}	-0.22337	0.69288	0.89249**	-0.82349**	-0.36859	0.33543
RH_{range}	0.66755	0.91710**	-0.44171	-0.75445*	-0.40369	-0.11923
GDD	0.51309	0.90776**	0.60387	0.66660	0.54633	-0.66400

* and ** indicate significance of value at P=005 and P=0.01, respectively; P_1 = Sowing to emergence P_3 = Branching to flowering P_5 = Capsule formation to Capsule development; P_2 = Emergence to branching P_4 = flowering to capsule formation P_6 = Capsule development to maturity

Table 7 : Correlation co-efficient between total biomass yield and different weather variables prevailed in various phenophases of linseed cultivar Garima

Weather variable	Phenophases					
	P_I	P_{II}	P_{III}	P_{IV}	P_V	P_{VI}
T_{max}	0.27752	0.67449	0.56380	-0.24945	0.88071**	0.72661
T_{min}	-0.22531	0.50829	0.75622*	0.32321	0.95955**	0.71391
T_{mean}	-0.10756	0.67194	0.90101**	-0.01348	0.94378**	-0.38942
T_{range}	0.29332	0.00178	0.41970	-0.28986	-0.72946	-0.92183
RH-I	-0.47577	0.66298	0.99023**	-0.83141**	0.64091	0.59411
RH-II	-0.30713	0.63624	0.95436**	-0.60203	-0.53968	0.74257
RH_{mean}	-0.3809	0.04995	0.98364**	-0.72856	-0.36193	0.71443
RH_{range}	0.14758	0.02248	0.48191	0.25936	0.14346	0.51539
GDD	-0.11242	0.84533**	0.47487	0.06418	0.87201**	-0.83491**

and ** indicate significance of value at P=005 and P=0.01, respectively; P_1 = Sowing to emergence P_3 = Branching to flowering P_5 = Capsule formation to Capsule development P_2 = Emergence to branching P_4 = flowering to capsule formation P_6 = Capsule development to maturity reported significantly positive correlation. Whereas, during P_4 stage (flowering to capsule formation) the weather has no significant effect, which indicates that this cultivar can withstand under varied weather setup.

V_3 (RLC-4) :

The correlation data presented in Table 5 revealed that during P_2 (emergence to flowering) the result exhibited significant positive degree of association in respect of RHI, RHII, RH_{mean}, and GDD. During P_3 stage (branching to flowering) almost all the weather variables showed positive significant association, except T_{range} and RH_{range}. Whereas, during P_4 stage (flowering to capsule formation) T_{min} and T_{mean} have reported significantly positive correlation.

Total biomass :

V_1 (Kiran) :

The data presented in Table 6 reported non-significant association during P_1 (Sowing to emergence) during P_2 (emergence to branching) the T_{max}, T_{min}, T_{mean}, T_{range}, RHII, RH_{mean} and GDD reported significantly association with total biomass yield. Whereas, RHI, RH_{mean} reported non-significant association. During P_3 stage (branching to flowering) T_{min}, RHI, RHII, and RH_{mean} reported significantly positive association with straw yield. The degree of association with straw yield and weather parameters studied. During P_4 (flowering to capsule formation) where only RHI, RH_{mean} and RH_{range} were negatively correlated with straw yield.

V_2 (Garima) :

The data presented in Table 7 showed that straw yield of this cultivar ranked first. Correlations studied indicated non-significant association. During P_2 stage (emergence to branching), except GDD all other factors have non-significant association with straw yield. During P_3 stage (branching to flowering), T_{min}, T_{mean}, RHI, RHII,

Table 8 : Correlation co-efficient between total biomass yield and different weather variables prevailed in various phenophases of linseed cultivar RLC-4

Weather variable	Phenophases					
	P_I	P_{II}	P_{III}	P_{IV}	P_V	P_{VI}
T_{max}	0.32273	0.36162	0.95248**	0.31312	-0.27259	0.31677
T_{min}	-0.55291	0.72648	0.72619	0.87141**	0.71991	0.71618
T_{mean}	-0.41974	0.57495	0.88524**	0.90426**	0.66824	0.53732
T_{range}	0.57378	-0.39203	0.50435	-0.45719	-0.81169**	-0.26487
RH-I	-0.48100	0.87807**	0.88933**	0.05524	0.12019	0.45617
RH-II	-0.57392	0.88850**	0.87208**	0.27259	-0.61771	0.42060
RH_{mean}	-0.52806	0.88621**	0.88116**	0.12326	-0.38201	0.44631
RH_{range}	-0.85122**	0.38637	-0.49233	0.49345	-0.04533	-0.14695
GDD	-0.75505*	0.94894**	0.67546	-0.05365	0.89679**	0.45100

* and ** indicate significance of value at P=005 and P=0.01, respectively; P_1 = Sowing to emergence; P_3 = Branching to flowering; P_5 = Capsule formation to Capsule development; P_2 = Emergence to branching; P_4 = flowering to capsule formation; P_6 = Capsule development to maturity

Table 9 :Impact of weather on seed yield as influenced by dates of sowing

DOS	D_1		D_2		D_3		D_4		D_5		D_6	
Weather variable	Veg.	Rep.	Veg.	Rep.	Veg.	Rep.	Veg.	Rep.	Veg.	Rep.	Veg.	Rep.
T_{max-}	-0.38597	-0.61635*	-0.21536	-0.60457*	-0.6782**	0.09289	0.38629	0.64097*	-0.10246	-0.75450**	0.00784	-0.6234*
T_{min}	0.01374	-0.6076*	-0.25370	-0.25575	0.76420**	-0.43400	0.69145**	-0.15132	-0.09433	-0.13533	-0.00072	-0.06213
T_{mean}	-0.31670	-0.22798	-0.27808	-0.48587	-0.44830	-0.19260	0.30895	0.15802	0.25876	0.25945	0.00175	-0.32381
T_{range}	-0.25190	-0.10216	-0.22917	-0.01288	-0.44385	0.30847	0.40468	0.35625	-0.21001	-0.01392	-0.00345	-0.13167
RH-I	0.08068	0.69126**	-0.13804	-0.01246	-0.23027	-0.06153	-0.20390	0.01840	0.19386	-0.95780**	0.02046	-0.12106
RH-II	0.06376	0.64895*	-0.16173	-0.67855**	-0.27895	-0.03940	-0.22312	0.23183	0.21404	-0.34816	0.01787	0.15446
RH_{mean}	-0.07210	0.73330**	-0.15081	-0.64257*	0.59540*	0.00532	-0.21428	0.13783	0.20192	-0.27227	0.01209	0.04870
RH_{range}	-0.20283	-0.65856*	-0.24553	0.08291	0.85150**	0.12366	-0.04856	0.44096	0.21320	0.0000	-0.1209	-0.15131
GDD	-0.09490	0.00058	0.18291	-0.60813*	0.24521	0.00473	0.19235	-0.21383	-0.20035	0.02739	-0.052254	0.034482

* and ** indicate significance of value at P=005 and P=0.01, respectively

and RH_{mean} reported significantly positive association with straw yield. During P_4 stage (flowering to capsule formation) only RHI reported significant negative association with straw yield than other weather parameters.

V_3 (RLC-4) :

The correlation data presented in Table 8 revealed that during P_2 (emergence to flowering) RHI, RHII, RH_{mean} and GDD had significant positive association with straw yield. During P_3 stage (branching to flowering) T_{max}, T_{mean}, RHI, RHII, and RH_{mean} exhibited significant positive association with straw yield. In the P_4 stage only two weather variables T_{min}, T_{mean} had significant positive association with straw yield.

Impact of weather on seed yield and total biomass as influenced date of sowing treatments :

In the present investigation, to assess the crop weather relationships in linseed crop, the treatment of sowing dates were imposed to expose the crop to different weather sets during crop period. To have an insight on the effect of individual weather element prevailed in different phonological stages of linseed crop, a correlation study was conducted and the degree of association between seed yield, straw yield and different weather elements were estimated and are presented in Table 9 and 10.

Seed yield :

The data on correlation co-efficient presented in Table 9 indicated that the weather elements had no significant effects during vegetative growth phase except in treatment D_3 and D_4. In treatment D_1 in the reproductive growth stage, T_{max}, T_{min} and RH_{range} exhibited significant negative association, while RH1,RHII and RH mean reported significant positive correlations with seed yield. In treatment D_2, T_{max}, RHII, RH_{mean} and GDD reported significant negative correlation whereas, no positive significant association was observed in reproductive stage of this treatment. In treatment D_3, during vegetative phase, T_{max} exhibited significant negative correlation while, T_{min}, RH_{mean} and RH_{range} reported significant positive correlation. However, in this treatment, no significant association was observed during reproductive growth stage. In treatment D_4, T_{min} reported positive significant correlation in vegetative phase, while T_{max} exhibited significant positive correlation during reproductive growth stage. In treatment D_5 and in D_6 not a single weather variable prevailed during vegetative growth stage reported significant association whereas, in treatment D_5 T_{max} and RHI and in treatment D_6 T_{max} had shown negative correlation.

Total biomass :

The data presented in Table 10 indicated that straw yield had varied treads in weather condition from D_1 to D_6. In treatment D_1 which had highest biomass yield al the parameters of weather reported non-significant association except T_{max}, T_{mean} and GDD which reported significant negative correlation with straw yield in vegetative phase while in reproductive stage same tread was followed with the addition of RH_{mean} parameter. In treatment D_2, in vegetative phase, T_{max}, T_{min} had shown

Table 10 : Impact of weather on total biomass as influenced by date of sowing

DOS	D1		D2		D3		D4		D5		D6	
Weather variable	Veg.	Rep.	Veg.	Rep.	Veg.	Rep.	Veg.	Rep.	Veg.	Rep.	Veg.	Rep.
T_{max-}	-0.7212**	-0.6751**	0.64228*	0.62282*	-0.21464	0.10172	0.64555*	0.14096	-0.22961	-0.02290	-0.01605	-0.38416
T_{min}	-0.20138	-0.10130	0.65716*	0.60560*	0.67440**	-0.25562	0.00190	-0.62715*	0.10019	-0.10931	0.12311	-0.18885
T_{mean}	-.69701**	0.59470*	0.62461*	0.66128*	-0.09566	-0.07140	0.60181*	-0.40655	0.67681**	0.68843**	0.09601	-0.43400
T_{range}	-0.15078	0.74987	0.03349	0.62140*	-0.35388	0.19142	0.64670*	0.44256	-0.16154	0.41151	-0.18988	-0.04820
RH-I	-0.01574	0.04819	-0.63209*	0.60174*	-0.22784	-0.02159	-0.05609	0.66123*	0.00284	0.05026	0.08377	-0.6316*
RH-II	-0.03198	0.00085	-0.07167	0.62020*	0.68490**	0.07948	-0.13966	0.75373**	0.01858	-0.45926	0.11462	-0.21650
RH_{mean}	-0.02402	0.02518	-0.10041	0.67706**	-0.6901**	-0.03514	-0.09738	0.73485**	0.01161	-0.28744	0.08516	-0.45265
RH_{range}	-0.24249	-0.60912*	-0.60186*	0.04674	0.46737	0.21849	-0.60183*	0.38252	0.15020	0.13658	0.07284	-0.30989
GDD	-0.62020*	0.77501**	-0.23361	0.67940**	-0.01384	0.01762	0.15168	-0.6688**	-0.04503	0.00555	-0.19578	-0.04657

* and ** indicate significance of value at P=005 and P=0.01, respectively

positive significant association while T_{mean}, RH-1 and RH_{range} had shown significant negative correlation. In the reproductive phase of D_2 treatment, all parameters of weather had significant positive correlation with straw yield except RH_{range}. In treatment D_3 T_{mean} and RH-1 had positive significance in vegetative phase while RH_{mean} had negative significant correlation other parameters have non-significant association. While in reproductive stage non-significant association with weather variables and straw yield was noted. In treatment D_4, vegetative phase had significant positive correlation with T_{max}, T_{mean}, T_{range} while RH_{range} had significant negative correlation, Other parameters had no any association with straw yield.

In respect of reproductive phase, parameters like RH-1, RH-II, RH_{mean} had significant positive correlation, while T_{mean}, GDD had significant negative correlation. In treatment D_5 and D_6 no any parameter had significant association except T_{mean} which had significant positive association in vegetative phase in D_5 treatment. While in treatment D_6, only RH-I parameter in reproductive phase had significant negative association in both the phases of linseed crop (Kulkarni and Benagi, 2012; Kulshretha and Kumar, 2013; Patel *et al.*, 2011 and Singh and Lal, 2012).

The above results indicted that the crop weather sensitivity followed similar trend with the results obtained in correlation studies between seed yield and weather variables.

Summary :

First date (D_1) and second date (D_2) crop sown in MW 40 and MW 41 recorded significantly higher leaf area index than other dates of sowing. Correlation study between seed yields and weather parameters of Garima cultivar reported significant positive correlation between T_{max}, T_{mean}, RHI, RHII, and RH_{mean} in P_2 stage (Emergence to branching) while at critical growth stages weather had no significant effect. In respect of cultivar kiran different trend was observed in P_4 stage (Flowering to capsule formation). Only T_{min} and GDD have reported positive correlation. When correlation study between straw yields and weather parameters of above cultivars was to known, Garima cultivar reported significant positive association with T_{min}, T_{mean}, RHI, RHII and RH_{mean} during P_3 stage (Branching to flowering). Cultivar Kiran have also reported significant positive correlation during P_3 stage (Branching to flowering). The significant negative correlation in respect of air temperature indicated that higher minimum temperatures are not ideal for optimum seed yield. The positive significant correlation of humidity values are explainable that higher air temperature indirectly decreased the humidity and there by seed yield.

Conclusion :

– The cv. GARIMA proved to be superior in recording more seed yield as compared to other cultivars.
– Sowing of linseed cv. GARIMA with first date of sowing MW 41 was found advantageous in recording more seed yield.
– Reproductive growth stage was found to be more weather sensitive as compared to vegetative growth stage.
– On the basis of above conclusion it can be indicated that the linseed cv. GARIMA be sown with date (40 MW) for higher yield under Marathwada condition.

Coopted Authors' :

B.S. ROKADE, K.T. MADANE AND P.S. KAMBALE, Zonal Agricultural Research Station, SOLAPUR (INDIA)

REFERENCES

Dixit, J.P., Chourasia, S.K., Aillai, P.V. A. and Khan, R.A. (1994). Assessment of flexibility of sowing time of linseed (*Linum usitatissimum*) cultivars under double-cropping system in Tawa Command. *Indian J. Agron.*, **39** (1): 105-109.

Doorenbos, J. and Pruitt, W.O. (1977). *Guidelines for predicting crop water requirements*, FAO-ONU, Rome, Irrigation and Drainage Paper number 24 (rev.), 144 pp.

Fisher, R.A. (1921). *Statistical method for research works.* Oliver and Boyd and Co. Inc. Endinburgh.

Fisher, R.A. (1970). *Statistical methods for research workers* (14^{th} Ed.). Oliver & Boyd, Edinburgh, Scotland.

Kulkarni, Sunil and Benagi, V.I. (2012). Effect of date on sowing and correlation of weather parameters on the incidence of anthracnose of greengram. *Internat. J. Plant Protec.*, **5**(2) : 349-351.

Kulshretha, A.K. and Kumar, Manoj (2013). Impact of weather parameters on incidence of chrysomelid beetles (*Zygogramma bicolorata* Pallister) in gajar-ghas (*Parthenium hysterophorus* Linn.). *Asian J. Environ. Sci.*, **8**(2): 143-144.

Panse, V.G. and Sukhatme, P.V. (1967). *Statistical methods for agricultural workers*, 1st Edn., ICAR, NEW DELHI (INDIA).

Patel, H.N., Kadu, R.V. and Landge, S.A. (2011). Study on seasional incidence of rice leaf folders (*Cnaphalocrocis medinalis* Guen. and *Pelopidas mathias* Fb.) of paddy and its correlation with weather parameters. *Internat. J. Pl. Protec.*, **4**(1) : 175-180.

Samui, R.C. and Bandopadhyay, Pinto (1991). Influence of date of sowing on linseed (*Linum usitatissimum*) *cultivars. Indian J. Agron.,* **37** (3): 599-601.

Sharma, J.J., Kapur, B.L. and Thakur, D.R. (1995). Performance of linseed (*Linum usitatissimum* L.) cultivars under varying dates of sowing in Kullu valley. *Himachal J. Agric. Res.*, **21**(1&2): 23-26.

Singh, Arun Kumar and Lal, M.N. (2012). Population dynamics of mustard aphid, *Lipaphis erysimi* (kalt.) on mustard in relation to weather parameters. *Asian J. Bio. Sci.*, **7** (2) : 216-218.

Verma, K.P. and Pathak, R.K. (1993). Response of linseed (*Linum usitatissimum)* cultivars to different dates of sowing. *Indian J. Agron.*, **38**(1): 60-63.