

transpiration in wheat production. Weather is the combination of natural phenomena as temperature, precipitation, light intensity and duration, wind direction and velocity and relative humidity. In any given location these weather factors assume a certain pattern changing day by day, week by week, month by month and season by season and the same pattern repeats year by year. This pattern is the location's climate.

Climatic factors influence all aspects and stages of plant growth and hence affect agricultural productivity and stability of production. Their influence extends from the upper limits of the atmosphere, in which spores and pollen are encountered, to the soil depth penetrated by the roots. Although water supply plays a dominant role in crop production, other climatic factors also have beneficial or negative effects on crop production.

Each climatic factor has a range of optimum intensity which differs with species. Beyond the limits of the optimum intensity, plant development is adversely affected, either by excess or deficiency of the factor involved. The resulting stress may cause physical or chemical changes, such as damages or destruction of enzyme that are vital to essential metabolic process, or they may simply cause a slowing down of these functions, that return to normal when the stress ceases. According to the degree of intensity, the effects of climate factors may therefore be favourable, neutral, harmful or lethal.

Although the climate for a given region is established and well known, extreme variation in weather pattern can eliminate a crop even though, on the average, such problems are unlikely. Or a little beneficial variation in climate may result in the form of bumper crop production as we have seen in the case of wheat during this year.

Wheat grown in Pakistan (more than any other crop) is adopted to a wide range of soils and climate and is extensively grown throughout the country wherever conditions of temperature, moisture topography and soil are conducive to its economic cultivation. Though wheat is a plant of wide range of distribution, it is primarily the cereal of moderately dry temperate climates.

Definite climatic factors determine where and to what extent wheat can or cannot be grown economically. Weather conditions have a marked influence on the growth of wheat as well as on the yield and quality of its grain. A great amount of crop performance data that has been accu-

classified as a long-day plant. Transition from vegetative to reproductive stage as well as the transition from initiation of growth to biological maturity does not depend on the day length factor alone but on both, length of day and temperature. It is commonly recognized that a definite amount of heat is required to bring a crop from planting to maturity. It is also commonly recognized that there are certain restricted time limits within which crops must be planted for best results defined by the temperature conditions of the locality. When sowing is delayed, the length of development periods generally decrease. Therefore, one day delay in sowing of wheat after 20th November results in reduction of grain yield by 10-12 kg per acre. Shortening of the development stages under the influence of high temperature, particularly in March and April, is usually accompanied by lowering in the grain yield of the wheat.

Low temperature during the month of January and February (Table 2) markedly affected the vegetative growth of wheat in 1999-2000 as compared to the previous years except the year 1998-1999 where we experienced foggy and misty weather of about one month (17th December to 14th January) during the highest vegetative growth period and due to the lack of sufficient sunshine, yield was affected. During the year 1999-2000, low temperatures had beneficial effect on the vegetative growth. Due to this, the wheat crop enjoyed the prolonged duration of net assimilation which ultimately led to more leaf area growth, more root growth and the maximum tillering.

Light has an over-riding effect on the rate of photosynthesis. As long as light is limiting, temperature has little effect on the rate of photosynthesis. However, when light is not limiting as was in Pakistan during 1999-2000, the effect of favourable temperatures on the rate of photosynthesis was increased. Likewise temperature during March and April in the flowering and grain filling stages of wheat, is an important determinant of wheat yields. When hot weather arrives early, the effect on yields is particularly important for late sown wheat. Fertilization of a single ear is completed after approximately six days and after 10 days, for all the ears of a plant. During this period the ears are extremely susceptible to injury by low temperature. So the favourable temperature during the March and April of the year 2000 favoured the good yield of wheat in Pakistan.

Rainfall: Most of the grain producing area lie in the tem-

perate zones of the world. The later stages of wheat crop, winds blowing due to the unequal heating of the soil surface adversely affect the crop. These winds are lethal for the wheat crop because if these winds and rainfall occur simultaneously the lodging of the wheat occurs which reduce the yield too much. As when lodging occurs shortly before earing, pollination is poor and if it occurs after earing, grain formation and maturation will not proceed normally

Out of many climatic factors, wheat plant is determined largely by temperature and rainfall.

because of the inadequate transfer of assimilates from the upper leaves to the grains. Luckily, no wind blew during March-April of 2000 which ultimately favoured higher wheat yields.

Heavy rains during the reproductive stage of wheat impair pollination. As the beating of rain drops at this stage may make the reproductive organs sterile which ultimately affect the number of grains per ear which is the most important yield component.

According to table 3, there were no or little rain during this period of the year 2000 and the pollination was optimum and hence higher yields were obtained.

A definite relationship exists between climate and plant diseases. Weather influences the incidence of disease by favouring the growth of pathogens itself and increasing the plants susceptibility to diseases. High humidity or an abundance of rain during March-April is the most important factor favouring the disease (rust) incidence.

During 2000 there was very low humidity due to the lack of rainfall in the months of March-April, which helped to minimize the effect of rust attack on wheat.

Future strategy: Climate is beyond our control yet efforts could be made for optimum utilization of the resources and micro climate may be modified in favour of crop growth. Five parameters as suitable variety, sowing at proper time, weed control, fertilizer and irrigation management, have direct influence on wheat yield.

Most of the present wheat varieties have yield potential between 5 to 6 tons per hectare, but this potential is not being exploited mainly due to late sowing, uncontrolled weeds, poor fertility and inefficient irrigation practices. Wheat yield in irrigated areas of Pakistan, can very easily be doubled by taking care of these four parameters. Many farmers are aware of the importance of these four factors but due to financial constraints, they are unable to use weedicides,

ing wheat yields. Two sprays of sorgaab (sorghum water extract) at 30 and 40 days after sowing, increases wheat yields by 20 per cent and combination of sorgaab with the soil application of optimum nitrogen or two foliar sprays of Nitrophoska @ 1 kg ha at booting and earing could further increase wheat yield by 25-30 per cent. The use of no-tillage seed planter for sowing wheat after rice and cotton is quite feasible because it utilizes the previous crops moisture by saving rauni irrigation, cuts cost for land preparation and could aid sowing at proper time i.e. upto 30th November. Salt tolerant wheat lines as Sarsabz, Bakhtawar and Sarc-1, may be sown in salt affected soils.

Government wheat policy: Government's wheat policy should be announced in early October each year so that the farmers could make their decisions accordingly. The support price of wheat must be reviewed every year and announced keeping in view the international wheat price. The wheat price adjusted according to international market, will not only encourage the farmers to grow more wheat but would also discourage smuggling of wheat to the neighbouring countries, particularly India. Some economists may not agree to this suggestion because of the resistance from urban populace. In our view poor people in the cities could be provided wheat or its flour on reduced rates or they could be helped with food stamps but the farmers should be given international wheat price so that they may be able to use recommended wheat production technology. If the farmers are satisfied with wheat price, they would grow wheat with greater enthusiasm, ultimately the national production of wheat would be improved and hence it will save precious foreign exchange.

The availability and quality of inputs as seed, fertilizer and pesticides, must be ensured by the government prior to sowing and during the crop growth at the rates a poor farmer could afford to purchase and use the recommended inputs. The fuel and electricity should also be provided to farmers at relatively cheaper rates and their supply must be ensured during entire growing season of wheat. One window system may be ensured during the entire growing season of wheat and it may be strengthened further by advancing interest free loans in the form of inputs (seed, fertilizer, pesticide) instead of cash.

It could be concluded that the main reason for bumper wheat crop during year 2000 was favourable climatic conditions provided by Allah Almighty, in irrigated areas of Punjab and Sindh i.e. cool, moderately moist growing season during January-February which helped the leaf growth and tillering. Later on, warm bright seasons provided maximum sunshine for photosynthesis, and the dry harvest period. The other reasons were the increase in wheat price from Rs. 240 to 300 per 40 kg the early sowing of wheat in the cotton zone.

Table 3. Average rainfall (mm) 1996-2000. perate zones of the world

Year	January	February	March	April
1996	13.7	97.0	29.0	70.0
1997	16.7	8.5	12.0	78.0
1998	0.0	15.7	9.5	47.0
1999	24.5	5.9	6.5	0.0
2000	16.2	19.3	0.3	0.0

Source: Meteorological section, Department of Crop Physiology, UAF.