Original Research Article

GeneticVariability studiesinF$_2$ Populationof the WheatCross DDK-1029x GPMDIC66

ABSTRACT:

The selection of breeding material heavily relies on genetic variation and its inherited components. A thorough understanding of genetic variation is necessary in order to develop an improved variety. Thus, genetic parameters were assessed in the F$_2$ population of the cross between DDK-1029 and GPM DIC 66. The genetic variability results indicated a moderate to high phenotypic and genotypic coefficient of variation for characters like days to 50% flowering, plant height, productive tillers per plant, spike length, spikelets per spike, grains per spike, thousand grain weight and grain yield. In contrast, the protein, iron and zinc contents exhibited low to moderate phenotypic and genotypic coefficient of variation. All the traits had higher heritability except for grain yield which exhibited a moderate heritability. All the characters exhibited significant GAM except for days to maturity, iron content and protein content which exhibited moderate GAM. This suggests that high genetic variation, heritability, and GAM for such traits will aid in their improvement through both direct and indirect selection.

Keywords: GCV, PCV, GAM, Heritability, Selection.

INTRODUCTION:

Wheat (*Triticum aestivum*L.), (2n=2x=42) is one of the world's most important foodcrops, supplying about 20 per cent of the world's dietary energy and total protein consumedLiu [1].InIndia,wheatisgrowninanareaof31millionhectaresandtheproductionof 105.4 million tonnes with an average productivity of 3295 kgha^{-1} Anonymous [2] .Uttar Pradesh, Madhya Pradesh, Punjab, Haryana and Rajasthan are the major wheat growingstates inIndia.The areaunder Karnatakais about1.68 lakh hectare with annualproduction of 1.72lakhtonneswithproductivityof1023kgha^{-1}Anonymous [3]. Wheatcontains1,370kilojoules(327kilocalories)offoodenergyin100gramsandisarichsourceofseveralessentialnutrients,suchasprotein,dietaryfiber,manganese,phosphorus and niacin (20 per cent or more of Daily Value, DV). There are many essential Bvitamins and other dietary minerals. Wheat accounts for 13% water, 71% carbohydrates and1.5% fat. Its 13 per cent protein content (75-80% of the protein in wheat) is mainly glutenShewry [4]. Micronutrient deficiency contributes to micronutrient malnutrition,which is a global issue, affecting more than 52 per cent of the world's population Hwalla [5].Overtwobillionindividualsarereportedlysufferingfrom"hiddenhunger"(deficiency of micronutrients). In particular, iron (Fe) and zinc (Zn) deficiencies are causingsevere health problems in developing regions for pregnant women and children under 5 yearsof age. Around 24.8 per cent of the global population and more than 65 per cent of pre-schoolchildren in Africa and South-East Asia are affected by anaemia, the largest cause of which isFedeficiencyWHO [6].Therefore, it is necessary to develop wheat varieties with improved yield, quality and resistance to pests and diseases in order to meet the world's growing demand for the grain. Considering the potential of this crop, there is scope for improvement and development of cultivars adapted for particular agro-ecological conditions. For the crop improvement program thorough understanding of the genetic varibility is required for different traits. Limited variability makes it difficult to achieve much, thus the breeder must either enrich the germplasm or to shift for polyploidy breeding, hybridization and mutation to create more variability. Genetic improvement of any crop requires appropriate breeding techniques for the creation and utilization of varibilty. More variability is typically produced in the early generations that than in the later Segregating generations. A sound breeding program can be planned with the help of assessments of genetic variation and the degree of desirable characters transmission. To determine if selection will result in a superiority of genetic advance, we have to evaluate the variability among the different traits when partitioning the total variation into heritable and non-heritable components.

Any crop enhancement program success is mostly determined by the extent to which genetic variation exists in the base population.Identifying and selecting the best segregants from the diverse population in the initial segreagting generation is crucial for self-pollinated crops like wheat. The current study aims to evaluate the genetic variability for yield and its associated characters in the F_2 population of the cross DDK-1029 × GPM DIC 66 .

MATERIALSANDMETHODS

The present investigation was carried out from November to February 2020 at the College of Agriculture, Dharwad, Karnataka. The two parents DDK-1029, a high-yielding variety with a moderate Fe and Zn content released by UAS, Dharwad and GPM DIC 66 (rich in grain Zn content) were involved in the development of the F_2 population. The F_2 population, which was produced by selfing of F_1 was planted in an unreplicated trial along with P_1, P_2 and F_1 and evaluated for yield and yield attributing traits. Twelve quantitative characters were recorded for each plant in the F_2 population. The following characters were examined: plant height (cm), productive tillers per plant, spike length (cm), spikelets per spike, grains per spike, thousand grain weight (g), grain yield per plant (g), days to 50% flowering (days), days to maturity (days), iron content (ppm), zinc content (ppm), and protein content (%).

StatisticalAnalysis:

The approach suggested by Burton [8] was used to compute statistical parameters such as mean, Vp, Vg, Ve and the phenotypic and genotypic coefficients of variation (PCV and GCV). The formula proposed by Lush [9] was utilized to calculate broad sense heritability. The johnson's suggested method [10] was used to calculate the genetic advance as a percentage of mean (GAM). Microsoft Excel was used to calculate all of the above characters.

RESULTANDDISCUSSIONS

Superior variety development will be largely depends on the avalibility of genetic variability. It is therefore essential to understand the degree of variability that exists. In the F_2 population of the cross DDK-1029 × GPM DIC 66 the results of mean, range, phenotypic variance, genotypic variance, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2), and genetic advance as a percent of mean (GAM%) are shown in Table 1. Based on results, there is relatively less difference between the genotypic and phenotypic coefficient of variance. Traits such as productive tillers per plant (54.41, 47.74) and grain yield per plant (57.63, 41.77) had higher PCV and GCV, suggesting larger levels of variability for these traits. Moderate PCV and GCV were shown by the traits like days to 50 per cent flowering (12.30,11.33),Plantheight(18.45,17.87),spikelength(16.97,15.36),spikeletsperspike(18.40,17.16), iron content (14.25, 11.74), zinc content (14.79, 13.63) and low PCV and GCV valueswereshownbydaystomaturity(8.11,6.95)andproteincontent(7.96,6.38). For every character, there is an environmental influence because the PCV is greater than the GCV. That is low, though, because there is less of a difference between PCV and GCV. GCVcan be used for the selection for further crop improvement. The level of PCV and GCV aredepictedinFig. 1.ThesefindingsweresimilartoNagaraju [11]andAshish [12]forthecharacterslikedaysto50percentflowering,daystomaturity, plantheight,productivetillers per plant, spike length, spikelets per spike, grains per spike, thousand grain weight andgrain yield per plant. The results were in line with Heidari [13], Naik [14], Srivijay[15],Arati [16] and Fyroj [17] for characters like iron content, zinc content and proteincontent.

Table 1:Estimation of genetic variability parameters for yield, yield attributing traits and grain micronutrients in the F_2 populations of the cross DDK-1029 × GPM DIC 66.

Sl.No.	Characters	Mean	Range		PCV(%)	GCV(%)	h^2bs(%)	GAM(%)
			MIN	MAX				

1	DFF	77.90	54.00	94.00	12.30	11.33	84.96	21.52
2	DM	114.30	91.00	131.00	8.11	6.95	73.48	12.28
3	PH	75.87	45.00	108.00	18.45	17.87	93.76	35.64
4	PTPP	17.06	4.00	41.00	54.41	47.74	76.97	86.28
5	SL	9.44	6.00	12.00	16.97	15.36	81.93	28.64
6	SPS	22.80	14.00	30.00	18.40	17.16	86.97	32.96
7	GPS	40.70	24.00	60.00	20.63	18.32	78.83	33.51
8	TGW	37.66	27.95	49.16	20.82	19.64	89.02	38.18
9	GY	26.83	7.00	72.00	57.63	41.77	52.55	62.38
10	Fe	47.10	38.40	65.20	14.25	11.74	67.90	19.93
11	Zn	47.80	34.00	63.30	14.79	13.63	84.91	25.88
12	Protein	16.30	14.00	18.60	7.96	6.38	64.25	10.53

DFF- Days to fifty per cent flowering, DM- Days to maturity, PH- Plant height (cm), PTPP- Productive tillers per plant, SPS- Number of spikelets per spike, SL- Spike length (cm), GPS- Grains per spike, GY- Grain yield per plant (g), TGW- Thousand grain weight (g),Fe- iron content (ppm), Zn- Zinc content (ppm), Protein content (%).

The degree to which traits are passed on from parents to their offspring can be evaluated well by heritability. It facilitates the selection of superior genotypes from a range of genetically diverse populations. Heritability for the following characteristics was found to be high: days to 50% flowering (84.96), days to maturity (73.48), plant height (93.76), number of productive tillers per plant (76.97), spike length (81.93), spikelets per spike (86.97), grains per spike (78.83), thousand grain weight (89.02), iron content (67.90), zinc content (84.91) and protein content (64.25) except for grain yield, which had a moderate heritability (52.55). The level of heritability for alltraits are depicted in Fig. 3. The results were in agreement with those of Ashish [12],Surya [18],Danial [19],Nagaraju [11]andRanjana [20].

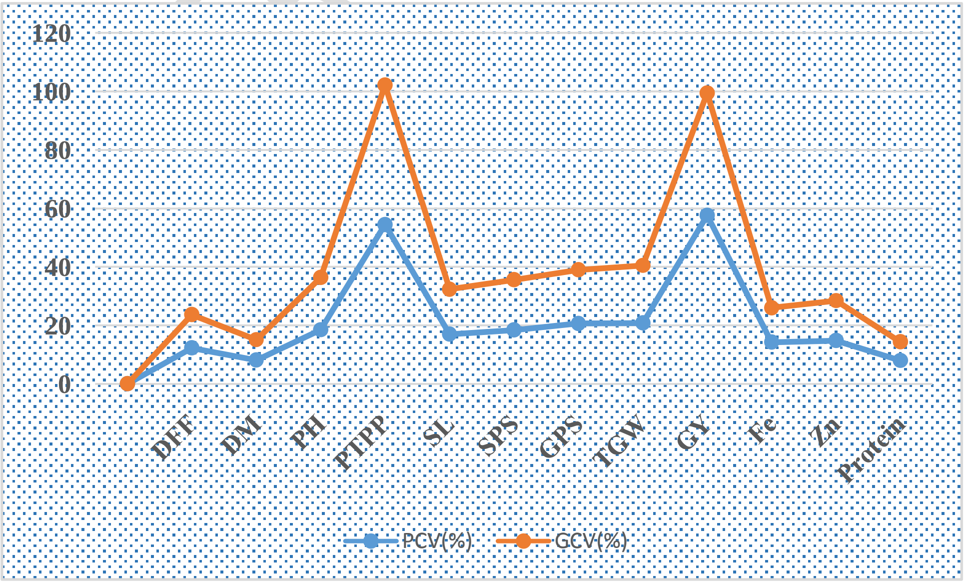

Fig. 1. Estimation of PCV and GCV for yield, its attributing traits and grain micronutrients in F_2 population of the cross DDK-1029 × GPM DIC 66.

For traits like days to 50 per flowering (21.52), plant height (35.64), number of productive tillers per plant (86.28), spike length (28.64), spikelets per spike (32.96), grains per spike (33.51), thousand grain weight (38.18), grain yield per plant (62.38), and zinc content (25.88), there was a high genetic advance as a percentage of mean. The genetic advance as a percentage of mean was low for characters like days to maturity (12.28), iron content (19.93), and protein content (10.53).The level of genetic advance as percent of mean for all traits are depicted in Fig. 3. Thetraits like days to 50 per flowering(days), plant height (cm), number of productive tillers perplant, spike length (cm), spikelets per spike, grains per spike and thousand grain weight (g)showed high heritability with high genetic advance. This indicates the presence of additivegene effects and selection is effective for these traits. These findings are similar to the resultsof Singh [21], Kyosev [22], Srinivas [23], Danial [19] andNagaraju [11].

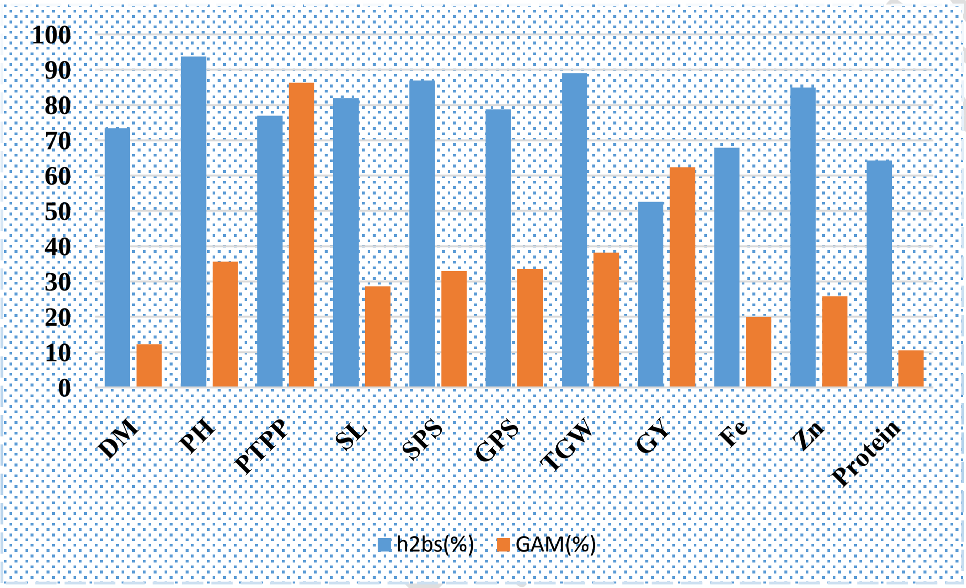

Fig. 1. Estimation of Heritability and GAM for yield, its attributing traits and grain micronutrients in F_2 population of the cross DDK-1029 × GPM DIC 66.

CONCLUSIONS

Higher levels of genetic variability was observed in the following characters: days to 50 per flowering (days), days to maturity (days), plant height (cm), number of productive tillers per plant, spike length (cm), number of spikelets per spike, number of grains per spike, thousand grain weight (g), number of grains yielded per plant (kg), and levels of iron, zinc, and protein (ppm). The same characters however, showed a significant degree of heritability along with genetic advance as a percentage of mean, suggesting that there is a greater potential for development in these traits by direct selection.

FUTURESCOPE

The results of this study showed that the F_2 segregating population possesses an enormous amount of genetic variation. Therefore, superior wheat varieties with high yield and quality can be developed by applying particular breeding techniques to harness the variance.

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