

## A high yielding semi-dwarf *dicoccum* wheat - Nilgiri Khapli (HW 1098) released for cultivation to *dicoccum* growing areas of India

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### ABSTRACT

A new high yielding, disease resistant semi-dwarf *Triticum dicoccum* wheat variety HW 1098(Nilgiri Khapli) has been released by Central Sub-committee on crop standards and notifications and release of variety for agricultural crops to all the *dicoccum* growing zones in India under timely sown irrigated conditions during 2013. It has mean grain yield of 45.53q ha<sup>-1</sup> with maximum yield potential of 47.8q ha<sup>-1</sup>, recording relatively lesser yield loss under late sown conditions when compared to checks. The variety has sown high degree of adult plant resistance against all the three rust under field conditions and SRT data indicated resistance response to all the pathotypes of brown, stem rust and to all yellow rust pathotypes except race 78S84(Mixed reaction). HW 1098 a mutant possesses at par quality with NP 200 a traditional *dicoccum* variety with high protein(16.5%) higher grain weight(46.5g), sedimentation value(29.0ml) and higher  $\beta$ -carotene(3.39ppm) and having an ideal plant height(85cm)

**Key Words:** Dicoccum, wheat quality, diabetes

### 1. Introduction

India is one of the few countries in the world which cultivates three species of wheat viz., *Triticum aestivum*, *Triticum durum* and *Triticum dicoccum* and the percent share of wheat production for each is in the order of 94.0%, 4.0% and 1.0 % respectively to produce 94.88 million tonnes wheat during 2011-12 crop season(Anonymous, 2012). *Triticum dicoccum* wheat commonly known as Samba, Jave, Sadaka or Khapli is produced closer to 10 million tonnes in India, mainly from the states of Maharashtra, Karnataka, Gujarat and in some parts of Tamil Nadu and Andhra Pradesh. Dicoccum, the hulled wheat differs from commercially available bread and durum wheat, by its physical characteristics, nutritional and processing quality parameters and also, cultivation practices (Patil *et.al*, 1999) In the last decade, there was significant increase in area and production for *dicoccum*. The increased market demand can be attributed to factors such as public awareness on the role played by *dicoccum* as health food since *dicoccum* based food products have low digestibility and low glycaemic value(Bhuvaneshwari, 1999). Moreover

it has been considered as a therapeutic food in the management of diabetes (Yenagi *et.al* 2001). Past one decade, several semi-dwarf *dicoccum* wheat varieties were released for cultivation to replace the traditional and tall Indian *dicoccum* varieties like NP 200 and NP 201 (released during late 1960's). But many of these semi dwarf varieties do not have the actual grain quality as that of the NP 200 or NP 201, which can be attributed to the fact that the dwarfing genes for the semi-dwarf varieties were derived from durum wheat, which has strong linkage drag for quality traits. Since the market demand for *dicoccum* is very high, both the farmers and millers are looking for such variety with high yield potential with better end use quality. Hence an attempt was made at IARI, Regional Station, Wellington to develop a semi-dwarf wheat variety with high yield potential and matching grain quality as that of traditional tall varieties employing gamma-irradiation technique which resulted in developing the variety, HW 1098. The high yielding wheat variety HW 1098 (Nilgiri

Khapli) has been now released for cultivation considering its performance in the all India co-ordinated yield trials.

At Indian Agricultural Research Institute, Regional station, Wellington, Tamil Nadu, a well planned wheat improvement strategy was taken up to develop a semi dwarf, high yielding, disease resistant *dicoccum* wheat variety and it has led to the development and release of the variety HW 1098 as 'Nilgiri Khapli'. The variety developed through irradiation technique (200 gray, selection of desirable single plant with high tillering and resistant to rust diseases at M2 segregating materials were followed with standard protocol of BRAC which is proved to give variability than the EMS treatment which is used only for point mutation. The final constitution of line was done at  $M_9F_9$ , Desirable moisture content of seed bellow 10% causes no much lethality) consistently out yielded the checks of *dicoccum*, *aestivum* and *durum* throughout the three years of testing under All India co-ordinated yield trials across all the *dicoccum* growing areas with mean grain yield of 45.53 (Table-1) q/ha and also possessed better grain quality (Table-2) as that of historic check NP 200. The variety has been recommended by the Central Sub-committee on Crop Standards, Notification and Release of varieties for further release and notification during 2013 for the *dicoccum* growing areas in the states of Gujarat, Maharashtra, Karnataka and Tamil Nadu under timely sown, irrigated conditions. This variety 'Nilgiri Khapli' will be an alternative to the currently cultivated *dicoccum* varieties and also will be boon to the farmers who are looking for an alternate variety giving higher yield combined with better grain quality as that of the traditional varieties as preferred by the millers.

*Problems and constraints in the area of its recommendation and justification for the variety HW 1098:* The *dicoccum* areas in the country is well spread across the three wheat growing zones of India namely Central zone, Peninsular zone and Southern hill zone. In the recommended zone the winter periods are relatively short and often witnessed by bouts of high temperatures triggered by weather disturbances arising from Bay of Bengal which favours the *Sclerotium* foot rot. Interestingly only in these region all the three types of wheat viz., bread wheat, durum wheat and *dicoccum* wheat are cultivated in India. More importantly it is the migratory path for spread of black and brown rust to the Gangetic plains (Nagarajan and Singh, 1990). The resource poor farmers in these areas were traditionally growing *dicoccum* primarily for its heat tolerance, non shattering properties and its nutritional quality traits (for traditional food preparations). The market demand for *dicoccum* has spiked many fold in the recent past which can be attributed to the fact that *dicoccum* is considered as therapeutically important cereal food crop which has better quality traits such as high protein (>15%) with easy digestibility, quality fibre and low glycaemic index (slow release of calorie) etc. Currently more and more areas

are coming under *dicoccum* cultivation which is attributed to increased demand from the millers (NB: *Dicoccum* is of hard threshing type, needs special hulling machines and hence most of the harvest goes to the flour mills for further processing). However, most semi-dwarf varieties released over last one decade or more derived their dwarfing genes from *T.durum*. Due to its strong linkage drag for quality traits associated with dwarfing gene(s) these varieties do not possess the grain quality as that of traditional varieties viz., NP 200, NP 201 and NP 202. Therefore farmers and millers are looking for a high yielding, disease resistant *dicoccum* wheat variety with better end use quality. Moreover, a *dicoccum* variety developed for this area should have same or higher yield potential over the *aestivum* and *durum* wheat with high degree of disease resistance, to brown, black rusts and foot rot. The variety HW 1098 (Nilgiri Khapli) recommended for these region was developed using irradiation technique with NP 201 as parent. The irradiation technique has resulted into a semi-dwarf genotype with high yield and disease resistant one without altering its quality. Thus cultivating this *dicoccum* variety HW 1098 is expected to give better return to the farmers and thereby it will help in sustaining the livelihood of the farmers.

*Varietal traits:* The variety developed using 'gamma irradiation' technique shows pink coleoptiles with anthocyanin pigmentation during early germination, possess erect growth habit, dark green leaves, profused tillering with medium length and broader leaves, erect flag leaves, parallel ear shape and some time little tapering, dense ear with long awns (Generally no morphological comparisons other than the above was carried out). The variety matures in about 106 days with average plant height 85 cm, producing hard threshing grains and capable of yielding more than 45q/ha.

*Adaptability to changing agronomical practices:* The genotype HW 1098 consistently out yielded over the *dicoccum* checks, when tested under normal & late sowing conditions recording an overall mean yield of 40.47q/ha and 32.73q/ha respectively across the zones (Table-3). There are relatively lesser yield loss compared to checks when sown in late sown conditions indicating its ability to adapt to short winter conditions and terminal heat stress occurring in the recommended areas.

*Disease Resistance:* The variety HW 1098 has shown high degree of seedling and adult plant resistance, particularly for leaf and stem rust. The recommended zone is acting as secondary foci for multiplication and further spread of leaf and stem rust (migratory route in Puccinia path). Cultivation of HW 1098 *dicoccum* variety along with *durum* and *aestivum* in a mosaic pattern will curtail further spread of rusts.

*Quality traits of HW 1098:* The variety HW 1098 produced bold, lustrous grain with 46.5g grain weight, comparable level of protein (16.8%), sedimentation value (29.0ml) and Beta carotene (3.39ppm) as that of traditional variety NP 200, coupled with higher yield potential and disease resistance will certainly a factor for farmers preference.

**Table 1.** Performance and grain yield (q/ha) of HW 1098 over three years of testing across the zone

	HW 1098	Checks			CD
		DDK 1009	MACS 2971	MACS 2496	
2009-10	10 41.3(=)	33.9	38.3	41.0	1.7
2010-11	12 47.5(+)	41.6	42.0	44.2	1.7*
2011-12	08 47.8(=)	43.4	45.7	43.9	2.3
Mean over the years	30 45.53	39.6	42.0	43.0	
Frequency in top group (Three years pooled)	23/30**	03/30	13/30	14/30	

\*Significant at 5 per cent level of significance \*\*In three years of testing the variety HW 1098 figured 23 times out of 30 times in top group  
**Source:** Project Director's reports. All India co-ordinated Wheat and Barley Improvement Project, DWR, Karnal, India, 2010, 2011 and 2012

**Table 2.** Comparison on quality traits of *dicoccum* variety HW 1098 with historic *dicoccum* check variety NP 200 and other *dicoccum* checks (mean values).

Quality Traits	HW 1098**	NP 200	DDK 1009#	MACS 2971#
TGW (g)	46.5	44.7	41.6	40.9
Moisture (%)	13.0	12.5	13.3	13.05
Protein (%)	16.8	17.25	12.7	14.8
Sedimentation Value (ml)	29.0	31.5	28.5	26.5
Yellow pigment/Beta carotene (ppm)	3.39	3.23	2.73	2.56

**Source:** Project Director's reports. All India co-ordinated Wheat and Barley Improvement Project, DWR, Karnal, India, 2012

The recommended variety HW 1098 has the ideal plant height (semi-dwarf) with dark green foliage and strong resilient stem (non lodging) which is likely to give better response to higher doses of fertilizer resulting in higher grain yield. It has better grain quality as that of traditional *dicoccum* varieties with better grain weight (39.9g) and high protein content (> 13%). Thus the cultivation of 'Nilgiri Khapli' will be remunerative to the farmers because of its consistent yield performance (mean grain yield of 45.53q/ha) and the preference for the consumers which ultimately results in sustaining the livelihood of the farmers in the recommended areas. This variety will act as an additional genetic barrier against the spread of brown and black rust in the migratory path (*Puccinia* path) because of its high degree of rust resistance and would increase the genetic diversity in the *dicoccum* cultivating zone.

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